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INSTITUTE OF GAS TECHNOLOGY

THE GAS INDUSTRY'S OWN EDUCATIONAL AND RESEARCH FACILITY

CHICAGO 16, ILLINOIS

GAS ABSTRACTS

DECEMBER, 1960

VOLUME 16 NUMBER 12

AFFILIATED WITH

ILLINOIS INSTITUTE OF TECHNOLOGY

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GAS ABSTRACTS is published and distributed monthly by the Institute of Gas Technology, Chicago 16, Illinois. The contents of selected papers and patents are reviewed impartially by the editorial staff and material of potential interest to the Gas Industry is presented.

Subscription rates to nonmembers of the Institute: $18.00 per year to U. S. addresses; $22.00 foreign. Regardless of the month in which it is entered, each subscription starts with the January issue. A gold-stamped fabrikoid binder for the year, and title- and end-pages for that volume, are sent with the January issue. A complete index to the year's issues is mailed as soon after the year's end as it can be prepared, edited and printed.

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A microfilm edition of Gas Abstracts can be supplied by University Microfilms, 313 N. First St., Ann Arbor, Michigan.

1. MANAGEMENT

Natural Gas

Marketed Production of Natural Gas Passes 12 Trillion Level; Consumption Rises 10%. *Gas Age 126,* 38 (1960) Nov. 10 (3 pp.); U.S. Bur. Mines Market Report *3132.*

Marketed production of natural gas in the United States totaled 12,046 billion CF in 1959, 9% more than in 1958, the latest Bureau of Mines report reveals. Total consumption in the United States in 1959 reached 11,820 billion CF, a 10% gain over 1958. By classes, consumption was: residential, 2913 MMCF; commercial, 975 billion CF; industrial fuel, 5980 billion CF; field use, 1737 billion CF, and carbon black, 215 billion CF.

Natural Gas. Part 1. A. N. Sharp. *Coke and Gas 22,* 482 (1960) Nov. (8 pp.)

Discussion of the worldwide exploitation of natural gas deposits and the international impact of this fuel on the postwar gas industry. Author first talks about growth and development of natural gas, pointing out that in the past decade this commodity has experienced dynamic growth not only in the U.S.A. but in countries as widely separated as Canada, France, Italy, Russia, Austria and the Middle East, to name a few. Design of long-distance transmission lines also is mentioned.

U. S. Gas Supply Limited Need 625,000 More Wells. D. T. Searls. *Drilling 22,* 72 (1960) Nov.

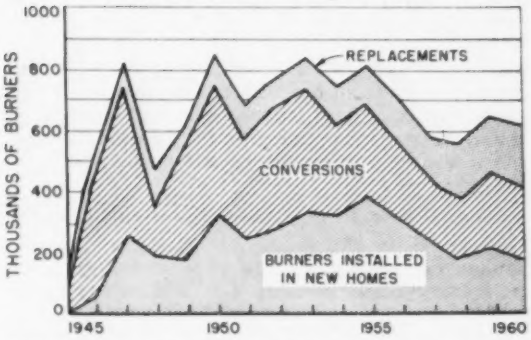
Present drilling rates must be increased by 50 per cent if we are to obtain the supply of natural gas to meet the increased demand of the 60's but producers cannot be expected to risk their money drilling such additional wells at the present field prices for natural gas. Despite present supplementary natural gas imports from Canada and Mexico, the strength of the U. S. natural gas business in the future is going to be determined by the strength of domestic gas supply. But the industry will have to transcend all previous efforts in the current decade by drilling 625,000 wells during the 1960-70 period.

Gas Industry Expansion

Using Scotland's Natural Resources — Gas. D. C. Elgin. *Gas World 152,* 683 (1960) Nov. 12 (5 pp.)

Supergrid about 140 miles long is under construction in central Scotland; when completed, this grid will supply widely separated undertakings. It will operate at high pressure and will collect and distribute gas from a number of sources, including: the Lurgi pressure gasification plant being constructed to gasify coal of high inert content from the Westfield opencast mine; methane from Cardowan colliery, Lanarkshire, and possibly Valleyfield colliery, Fife; refinery gas from Grangemouth; coke oven gas from Colville's Clyde ironworks and Ravenscraig steelworks, Bairds and Scottish Steel, Ltd., Gartsherrie ironworks, National Coal Board, Dumbreck coke ovens.

Domestic Oil Heating Trends



(Adapted from *A Crisis in Fuel-Oil*...See Abstract, p. 271)

Education

Gas Industry Has Its Own College at IGT. R. T. Ellington. *A.G.A. Monthly 42,* 10 (1960) Dec. (4 pp.)

Chairman of Institute of Gas Technology's education program explains objectives and scope of its vast format. The several divisions include the undergraduate and graduate programs; summer sessions, which are geared to facilitate the transition of engineers from other major fields into the gas industry, and to assist in keeping men with a number of years' experience up to date; and home study courses, designed to assist nonengineering personnel throughout the industry gain broader knowledge of the industry's operations without leaving their place of employment. The first three-mentioned programs are conducted at IGT.

Exploration

Prepare Now to Drill 92,000 Wells a Year. M. T. Halbouty. *Drilling 22,* 75 (1960) Dec. (2 pp.)

Author cites several experts, one of whom contends that by 1985 all of the now known 275 billion barrels of world oil reserves will have been consumed and, in the meantime, it will be necessary to find at least that much more oil. No more than 75 billion barrels will be found in the Persian Gulf area. Author believes that U.S. oil companies now importing some 1.7 million barrels of relatively cheap foreign oil into the country daily in competition with domestic production should use the profits from that oil to seek the reserves that the United States will need in the future.

Federal Power Commission

Should Regulatory Commissioners Come from Staff Personnel? L. Smith. *Public Util. Fortnightly 66,* 871 (1960) Dec. 8 (12 pp.)

There appears to be a modest trend in recent times toward promoting outstanding staff experts to commissionerships. The result would seem to be conducive to more proficient and efficient commission members. A career in public regulation has much to recommend it, especially if it is possible to achieve a top spot. But there are differences of opinion as to whether this is good policy.

Foreign Activities

Argentina—Rising Star. *World Petrol. 31,* 44 (1960) Dec. (3 pp.)

President Frondizi's oil policy has raised petroleum production by about one-third and brought nearly one billion dollars in fresh international oil investment. A major gas line is soon to begin construction with major efforts underway in exploration and petrochemicals as well.

Brazil's Oil Hunt. R. G. Walker. *World Petrol. 31,* 64 (1960) Dec. (3 pp.)

Exploration research has now penetrated Brazil's ten sedimentary basins covering 1,351,000 square miles, or 41% of the national territory. During 1960, activity was concentrated on five points: 1) the Middle Amazon River; 2) the San Francisco Estuary, where two wells are producing oil in small but commercial quantities; 3) Sao Paulo; 4) Santa Catarina; and 5) Mato Grosso. In the two last-named states, oil has been found in noncommercial, but encouraging, quantities in recent exploratory wells.

China's Mineral Wealth and Metal Production. K. P. Wong. *J. Metals 12,* 945 (1960) Dec.

During the early years of the industrialization program in Communist China, emphasis has been placed on basic goods; hence additional time will be needed to make large quantities of the more complicated products. However, regardless of the current stage of industrial development, it is apparent that the necessary forward momentum has been created. The many capital construction projects being brought into production, and the additional projects being initiated confirm this observation. The accuracy of Communist China's industrial statistics can be questioned, but their order of magnitude is clear.

Colombia's Oil Keeps Pace. E. Ospina-Racines. *World Petrol. 31,* 50 (1960) Dec. (6 pp.)

Compared to the century of progress in the oil industry in the United States, the oil industry in Colombia has had a half-century of developments. The first two oil concessions were granted in 1905—De Mares and Barco. First drilling for oil took place on the Caribbean coast in 1907. In a half-century, Colombia has attained an oil output of 150,000 bbl/day of which some 52,000 bbl/day are currently consumed in Colombia, and there is a surplus exported which runs from 80,000 to 100,000 bbl/day, including fuel oil.

Oil Struggle in South America. J. E. Rasmuss. *World Petrol. 31,* 58 (1960) Dec. (4 pp.)

South America's west coast is a land of contrasts. Ecuador invites oil companies to try again to find oil, while Peru threatens nationalization of her largest producer. Colombia benefits from Venezuela's adversity while Chile continues on a level keel with her first mainland production this year.

Red China Claims Large Oil Resources Are Being Developed. R. Westgate. *World Oil 151,* 138 (1960) Nov. (9 pp.)

In 10 years Red China has boosted oil production from approximately 2000 to about 60,000 bbl/day. During this time, a survey for petroleum has been carried out on ½ million square miles and the aggregate well drilling reached more than 11 million feet. The Yumen, Yenchang and Tushantzu oilfields in Kansu and Shensi Provinces have been expanded, and new fields have been discovered in Sinkiang, Chinghai and Szechwan Provinces.

Strike in Cambay Area Promises Big Field. *Oil Gas J. 58,* 157 (1960) Nov. 21.

New discovery in the Ankleshwar area (about 300 miles north of Bombay) of western India indicates that area may be the best oilfield in the country. Tests on the Ankleshwar 1 wildcat show the well on commercial production will be good for about 300 tons, or about 2100 bbl/day. Ten more field wells are scheduled by the end of next year. Another 20 may be drilled in 1961. If development drilling lives up to the discovery's promise, the field could be the most prolific in India.

Venezuela's Changing Oil Policy. F. R. Parra. *World Petrol. 31,* 40 (1960) Dec. (6 pp.)

Drastic changes in the last three years include higher taxes, government control of export prices, direct government participation in the oil industry, and a more control-bent attitude. Success or failure of these policies will greatly influence policies of other oil-producing countries which follow Venezuelan developments.

Petrochemicals

Petrochemicals 1960. *Petrol. Refiner 39,* 161 (1960) Nov. (62 pp.)

Extensive review of the state of the art in polyolefin resin processes. Based on a comprehensive patent (360 cited) and literature search, this article brings earlier reviews up-to-date.

Petrochemicals Still in Building Forefront. R. B. Bizal. *Oil Gas J. 58,* 119 (1960) Dec. 5 (7 pp.)

Refinery report shows 41 projects under way or planned in U.S. and Canada. Petrochemical construction continues at high level with 98 projects. Giant Kansas plant highlights field processing activity. Refinery rundown includes first Lomax and Isocracking units.

Phthalic Anhydride. *Chem. Week 87,* 85 (1960) Dec. 10 (13 pp.)

World capacity of phthalic anhydride capacity has doubled since 1955 from 589 to 1154 million lb. By the end of 1961 it will be 1650 million lb, half again as big as it is now. The world expansion now going on is the backdrop against which future export market for phthalic must be assessed. It is already having a big effect on the U.S. supply of raw materials—naphthalene and ortho-xylene.

Pipeline Construction

India May Build Long Products Pipelines. *Oil Gas J. 58,* 54 (1960) Nov. 28.

Indian government is considering construction of a series of product lines that would interlace the country

within five years. The longest of the systems would be a 600-mile products line across northern India from Barauni to Delhi. Products would be supplied by a 40,000-bbl refinery to be built at the Barauni terminal of a 720-mile 14- and 16-in. pipeline system carrying crude from the Nahorkatiya area of Assam. A 260-mile 16-in. pipeline outlet from Nahorkatiya is now under construction to a refinery being built at Gauhati. This will be extended as a 460-mile 14-in. line to the second refinery at Barauni. Oil India, the successor to Assam Oil as the operating company, has now completed 85 deep wells in the Nahorkatiya, Moran and Hugrijan licenses in the Brahmaputra Valley. Fifty-eight of the tests have already been successfully completed as oil producers.

Upper Midwest Gets Canadian Gas. *Pipeline Eng. 32,* D-25 (1960) Dec. (3 pp.)

Midwestern Gas Transmission Co., a subsidiary of Tennessee Gas Transmission Co., has begun operation of its new pipeline project which will supply the upper Midwest with natural gas. The 504-mile 24-in. pipeline has the capacity to transport 204 MMCF/day of natural gas from western Canadian fields. Midwestern purchases the gas from Trans-Canada Pipe Lines, Ltd.

Process Design

Economics Are Basic for Plant Location. E. von Allmen. *Chem. Eng. Progress 56,* 37 (1960) Nov. (5 pp.)

In selection of chemical plant sites, raw material and market locations are traditionally the primary considerations. In a given situation any of a number of physical and chemical characteristics of the starting material or finished product may fix the site location fairly rigidly. New developments in shipping are minimizing restricting influences and increasing the flexibility available in plant site chores.

How to Apply Statistics to Chemical Processes. T. L. Koehler. *Chem. Eng. 67,* 142 (1960) Dec. 12 (11 pp.)

Application of mathematical and statistical methods has proven to be a strong economic lever in the chemical industry. Part of the responsibility for future growth clearly rests with statisticians and mathematicians. There is a need for new and more powerful techniques particularly in nonlinear models. An equal responsibility rests with the physical and engineering scientist to become knowledgable in the use of these techniques.

Statistical Program Planning for Process Development. J. M. Carr, Jr. and E. A. McCracken. *Chem. Eng. Progress 56,* 56 (1960) Nov. (6 pp.)

Sequential fractional factorials can be used successfully to provide useful answers to a problem without requiring large experimental programs. Use of the results can be extremely valuable in guiding future studies. In recommending statistical programs for process development, one must 1) recognize the value of sequential pattern of investigating a problem, 2) provide flexibility in the program for changes, and 3) provide methods for converging on worthwhile answers in a rapid manner.

State Commissions

Panhandle Gas Field Gets Proration "Cure." *Oil Gas J. 58,* 76 (1960) Dec. 5 (2 pp.)

Big East Panhandle field comes under proration for the first time. Order should help cut drainage and nonratable take between leases and also between the East and West Panhandle fields. But a spacing dispute still exists.

Well Service

The Well Servicing Contractor Today. L. A. Murphy. *Petrol. Eng. 32,* (Drilling and Producing) B-19 (1960) Dec. (4 pp.)

Mr. Average Contractor's earnings this year have slipped from the level they reached last year, mainly because of a simple increase in the cost of doing business. He feels that he ought to be able to earn at least 15% net profit, but he would have to increase his prices 11% in order to realize this profit at his present level of activity.

2. ENERGY SUPPLY AND ECONOMICS

Competitive Fuels

Beyond the Mains. Wake Up, Everybody! Electric Heat Is Here! W. W. Clark. *Butane-Propane News 22,* 25 (1960) Dec. (3 pp.)

In an editorial, author warns that the pace of electric heat must be slowed. He cites the AGA, GAMA, the L.P. Gas Council and the API's Liquefied Petroleum Gas Committee as the four elements which cover practically all phases of the gas business. It is within their collective powers to retard electric heat's invasion of the market. But their efforts must be coordinated, and to this end each dealer is asked, "What should be done?"

A Crisis in Fuel-Oil Sales Is Brewing. *Oil Gas J. 58,* 42 (1960) Nov. 28 (2 pp.)

Situation looks this way: a home burner lasts 16-18 years. Time is approaching when a big batch of furnaces installed in the late '40's will have to be replaced. *But* fewer oilburners are being installed in new homes. Fewer home furnaces are being converted to oil. Within three years, nearly a million oilburners will become obsolete. Their owners must choose between fueloil and natural gas. This means that if the fueloil dealer expects to win this market, he will have to move now.

How to Swing Gas Users to Oil. *National Petrol. News 52,* 92 (1960) Dec. (3 pp.)

Meenan Oil Co. is seeking an oil-heat conversion market in Levittown, N. J., a giant development of 3700 gas hot-water-heated homes. So far the effort has been doing well. In about ten weeks of campaigning, the company could cite these accomplishments: 1) it had converted more than 200 homes to oil from gas, and had 486 solid leads left; 2) it was well on its way

to achieving a year-end sales quota of 300 conversions; and 3) Public Service Electric and Gas Co., the utility furnishing natural gas in the area, seemed on the defensive in an advertisement war.

Coal

Coal and Gas from Coal Mines. E. A. C. Chamberlain. *Gas World 152,* 680 (1960) Nov. 12 (3 pp.)

Paper reviews the reserves of coal in Scotland against a background of the estimated requirements of industrial and domestic markets up to 1980. Major developments in coal utilization are likely with the generation of electricity in the next two decades. In the gas industry the importance of the total gasification of coal is discussed in relation to the overall consumption of coal for gasmaking and the future availability of solid smokeless fuels to meet the requirements of the Clean Air Act.

Energy Sources

Energy in the American Economy, 1850-1975. S. H. Schurr, B. C. Netschert, V. F. Eliasberg, J. Lerner and H. H. Landsberg. (Baltimore: Johns Hopkins Press, 1960, $12.50.)

Book contains an interpretative summary and three main parts, plus detailed appendices of supporting statistics. Part I, dealing with the past century of energy use, looks at the detailed record of the major energy sources—wood, coal, oil and natural gas—separately and in combination. Part II deals with the future of energy consumption in total, and in terms of its composition and its pattern of use. In Part III the future of energy supply is examined in terms of the nation's reserve and resource position in coal, crude oil, natural gas, natural gas liquids and hydropower. Their potential availability in 1975 is estimated in light of the natural resource position and the prospects for technological advance.

Nuclear Energy

The Prospects for Nuclear Process Heat. J. H. Wright and D. R. Smith. *Chem. Eng. 67,* 123 (1960) Nov. 28 (6 pp.)

Low-temperature process steam from nuclear reactors is technically and economically feasible today. It is up to the process industries to take the initiative and make this concept a practical and commonplace reality, say authors.

Oil Shale

Chemical Evaluation of Illinois Oil Shales. W. J. Armon and O. W. Rees. (Div. of the Ill. State Geological Survey, Circu. 307), 1960 (22 pp.)

Four Illinois black shales and one limestone (Decorah) were selected for detailed study of the chemical and physical characteristics of products (mainly oil and gas) produced by retorting. Assay yields ranged from 7.3 to 13.3 gallons of oil per ton of shale pyrolized. Data indicate that the conversion of organic matter to oil was comparatively low for the shales, ranging from 8.5 to 13.4 per cent. The limestone from the Decorah formation showed a conversion of 58.9 per cent. Results reported provide information on characteristics of crude oil and gases from Illinois shales and serve as a basis for comparing shales and retorted shale products.

Eduction Apparatus. R. O. Dhondt, C. J. Welsh and K. Ghahremani (assigned to Union Oil Co. of California.) U.S. 2,954,329 (1960) Sept. 27.

This patent, similar to the process described in U.S. 2,954,328, claims a continuous rotating scraper blade of helical form, motor-driven and centrally supported above the top edges. The scraper devices are operated in a gas-tight compartment surrounding the top of the kiln.

Retort Apparatus and Method. R. F. Deering and H. F. Wilkinson (assigned to Union Oil Co. of California.) U.S. 2,954,328 (1960) Sept. 27.

Apparatus for processing solids such as oil shale with fluid means is claimed, with an improved discharge device for the spent shale. A vertical kiln has a perforated lower wall for airblast and is provided with a solids-feed pump to discharge solids upward. Combustion gases pass upward, with gas and oil separated in a disengaging zone while hot shale moves up through a heat exchange zone. As the shale reaches the level of the upper edge of the kiln, it is removed by a horizontally moving reciprocating ash scraper, and falls by gravity through sealed discharge chutes. An alternate form of scraper comprising swinging scraper bars pivoted at the kiln edge is claimed.

Petroleum

Operation Cost Cutting. *Oil Gas J. 58,* 131 (1960) Nov. 14 (12 pp.)

Domestic demand for petroleum, which for years expanded at the rate of 6% or more per year, has slowed to about a 3% annual increase. The result of this curtailed increase in demand is that oil companies which had built up a massive momentum have overshot the mark. The correction is found in cost cutting. And this shaving of the cost of doing business extends across the board, with exploration being hit the hardest. A positive effect of cost cutting concerns doing a job better. New information and new methods are available which make this a most promising avenue of approach.

Petroleum Reserves

An Economic Study: What it Costs to Find U. S. Oil. H. J. Struth. *Petrol. Eng. (Drilling and Producing) 32,* B-19 (1960) Nov. (7 pp.)

Operators spent $2.9 billion in a year seeking new reserves for highest cost per exploratory well on record . . . expenses exceeded wellhead value of production discovered. Article presents a few basic premises regarding oil industry's depletion provision: 1) future supply of U. S. oil is dependent upon increased exploratory drilling, at constantly increasing costs; 2) profits of oil producers have accrued from reserves

found earlier at much lower costs; 3) high costs and ill-advised threats against the industry's depletion provision have retarded exploratory drilling operations since 1956; 4) oil industry is reinvesting 36.4% of its gross revenue in search for new reserves, whereas the deduction for cost depletion averages only 22%, 5) without the depletion provision, investment of risk capital would be retarded and reserves could not be maintained at adequate levels; and 6) uninterrupted expansion of the petroleum industry, supported by an adequate depletion allowance, will provide greater ultimate tax revenues to the federal government.

A Key to the Future—A Review of the Economics of the U.S. Oil Producing Industry. G. D. Priestman. *J. Petrol. Tech. 12,* 11 (1960) Nov. (4 pp.)

Review makes no attempt to forecast the future. The "key to the future" can be found by an adequate appraisal of the basic factors which have influenced the industry in past years. Such an appraisal will produce intelligent forecasts. Unfortunately, in looking at the industry's history, forecasters have been hampered by a lack of reliable data. This will continue to hinder future efforts unless positive steps are taken now to establish the proper machinery for collecting and disseminating industry data. Merely to extrapolate past trends does not serve the purpose of forecasting. Such an approach fails to recognize either the reasons for past performances or the benefits to be derived from improved technology and economics, says author.

Probable Pattern of United States Petroleum Supply. K. E. Hill. *J. Petrol. Tech. 12,* 15 (1960) Nov. (3 pp.)

In the analysis, a simple expedient has been used—the assumption of constant increments in demand each year. By 1970, the increment likely will be 500,000 bbl/day. By 1975, domestic demand for petroleum liquids will total approximately 17 million bbl/day. This represents an increase of about 7 million bbl/day (or 70 per cent) during the period, or an average of about 3.6 per cent per annum.

Tar Sands

Processing of Bituminous Sands. P. W. Fischer (assigned to Union Oil Co.) U.S. 2,957,818 (1960) Oct. 25.

Process is claimed in which clays are separated from pulped bituminous sands in a sodium silicate pulping solution. The silicate washing agent diluted by hydrocarbons is separated by settling. The accumulated clay in this agent is removed by adding an alkylene flocculating polymer which rapidly settles silt and clay particles and permits recycling of the silicate.

Thermoelectricity

Heater Produces Own Power. *Appliance Manufacturer 8,* 80 (1960) Nov. (2 pp.)

Minnesota Mining and Manufacturing Co. has built a furnace thermoelectric generator. Adapted to a wall space heater, it powers the fan motor to provide forced convection. Thermoelectric modules, heart of the generator, are fitted with self-contained coiling fins over which cooled air is forced by the fan. The thermoelectric power circuit is driven by heat from the main burner while the thermoelectric control circuit is driven continuously by heat from the small pilot burner. Advantages of such a system: efficiency, reliability and operating economy.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Drilling

Big New Air Hammer May Cut Your Costs. *Drilling 22,* 64 (1960) Dec. (3 pp.)

Article has been abstracted previously. (See *Gas Abstracts 16,* 252.)

Care and Maintenance of Tool Joints. (Part 2, Engineering Practices Manual No. 3) S. G. Marshall and C. R. Frederick. *World Oil 151,* (1960) Nov. (8 pp.)

To better understand how the life of drill pipe may be extended, this section of the Engineering Practices Manual No. 3 on Care and Maintenance of Tool Joints discusses equipment requirements and rules for care and handling, including 1) breaking-in period, 2) general rules of care, 3) transportation and storage and 4) corrosion. (See *Gas Abstracts 16,* 251 Nov. 1960 for Part I.)

How to Calculate Bit Weight and Rotary Speed for Lowest-Cost Drilling. E. M. Galle and H. B. Woods. **Part 1.** *Oil Gas J. 58,* 167 (1960) Nov. 14 (5 pp.); **Part 2.** *Ibid.,* 160 (1960) Nov. 21 (7 pp.)

Authors first establish the mathematical relations for drilling rate, cutting-structure wear rate, and bearing life as functions of the drilling parameters. From these relations, the calculus of variations was used to find the manner in which weight and rotary speed should be varied. Part 2 shows how actual field problems can be solved to get the bit weight and rotary speed which result in the lowest cost. If weight and rotary speed are varied in the ideal manner, there are three cases to consider: 1) teeth limit bit life; 2) bearings limit bit life; and 3) teeth and bearings wear out simultaneously. The governing relations derived by the calculus of variations are different in the three cases. For this reason, an automatic digital computer and numerical methods were used.

New Electric Rig Is Compact, Portable, Flexible — for Rocky Mountain Drilling. F. R. Mayer. *Oil Gas J. 58,* 60 (1960) Nov 28 (4 pp.); **Rig 3: Exeter's Answer to Drilling Economics.** *Drilling 22,* 58 (1960) Nov.

Drilling company has converted its Rig 3 into what it feels is the most modern and flexible drilling rig in the Four Corners region. Now operating as a diesel-electric unit, the converted rig has improved overall operating efficiency through: 1) greater portability; 2) faster rigup and teardown; 3) increased drilling

rate; and 4) lower maintenance cost. At the same time, the rig still retains the flexibility of the split rig.

New Pipe Could Stretch Rig Depth Capacity, Reduce Moving Costs and Aid Directional Drilling. *Drilling 22,* 66 (1960) Nov.

Drilling industry opportunity to choose between steel and aluminum drill pipe drew near with announcement that the first commercial test of a full aluminum string had proved successful near Yorktown in DeWitt County, Texas. Here, Shell Oil Company Rig 25—originally designed for 7000-foot work—drilled No. 1 Alvin F. Sievers to 10,400 feet with aluminum drill pipe. Developed and manufactured by Reynolds Metals Company, the 4½-inch aluminum pipe was fitted with special steel tool joints engineered and made by Reed Roller Bit Company. Test shows a driller can pull an aluminum string off bottom, in air, from depths as great as 16,000 feet without taxing his rig one pound more than when he pulls 10,000 feet of steel drill stem.

A Practical Look at Slim-Hole Drilling. B. A. Aggers. *Petrol. Eng. 32,* B-34 (1960) Nov. (4 pp.)

Development of slim-hole technique and design of special, scaled-down mobile drilling equipment were intensified by the serious need of a cheaper way to drill and complete oil and gas wells. Author discusses efficiency and limitations of equipment.

Exploration

Deep Gas Search Sparks South Texas Exploration. R. I Jindra. *World Oil 151,* 97 (1960) Nov. (4 pp.)

Exploration programs have been revised in all major south Texas trends, with primary current emphasis on gas-condensate production instead of on oil. Deeper drilling is, and will continue to be, the most active form of exploration. Although fewer wildcats will be drilled as they go progressively deeper, a higher discovery rate will result from the more careful, selective preparation of deep prospects to be drilled. The Edwards trend from Webb County northeastward through Lavaca County should see numerous wildcats drilled in the near future. The Wilcox trend is especially active along the downdip fringe. The Frio-Vicksburg trend has been relatively inactive, although Hidalgo, Kleberg and Calhoun Countries have enjoyed some important recent exploratory successes.

Deep Wilcox, Frio and Edwards Spur Upper Gulf Coast Activity. H. S. McQueen. *World Oil 151,* 119 (1960) Nov. (5 pp.)

Upper Gulf Coast area of Texas (Railroad Commission District 3) has been marked by several significant deep, downdip discoveries during the past year. Important new developments range through the geologic column from the lower Cretaceous Edwards limestone upward through Eocene (lower and upper Wilcox and Yegua) and Oligocene (Vicksburg and lower Frio). In exploration thinking and activity, the search for gas continues to be emphasized.

Southwest Texas Exploration Centers on Edwards Trend. G. R. Pinkley. **Part I.** *Oil Gas J. 58,* 262 (1960) Nov. 21 (3 pp.); **Part 2. Here's an Editorial Tour of the Deep Edwards Trend.** *Ibid.,* 112 (1960) Nov. 28 (4 pp.)

Stretch of Texas brush land extending from the Rio Grande northeastward 200 miles to the center of Lavaca County has been brought to the attention of the oil industry by the discovery of a series of deep oil- and gasfields. Of the 22 fields discovered so far, 18 are gasfields, 3 are oilfields, and 1 produces both oil and gas. Four key wildcats are drilling along the trend and may reveal important new information bearing on its future.

Lisbon Anticline: Hottest Area in the Paradox Basin. *World Oil 151,* 89 (1960) Nov. (3 pp.)

New era is underway in Paradox Basin activity. The targets: Mississippian and Devonian production in the Lisbon anticline area of Utah and Colorado. In October, 15 wells, active drilling operations and locations were listed for the Lisbon area. Three dry holes increased total drilling to 18 wells. First announcement of gas flows ranging from 1.2 to 17 MMCF/day (with some condensate), through 450 feet of Mississippian section, received nationwide attention. Only Big Flat, to the northwest, was previously known for commercial production from Mississippian.

Reservoir Engineering

Field Use of Radioactive Gas Tracers. F. E. Armstrong. *Petrol. Eng. 32* (Drilling and Producing), B-34 (1960) Dec. (3 pp.)

Simple, effective and economical system for applying radioactive gas tracers to oilfield production problems has been developed by the Bureau of Mines. Although the detection method is less sensitive than some laboratory methods, advantages gained from continuous recording, lack of need for continuous attendance, and much lower cost, outweigh the necessity of using larger quantities of tracer. Techniques and instruments were first tested in a pilot water flood operation in the Spraberry Trend of West Texas.

Secondary Recovery

The Efficiency of Miscible Displacement as a Function of Mobility Ratio. B. Habermann. *J. Petrol. Tech. 12,* (Tech. Paper 8132) 264 (1960) Nov. (9 pp.)

Artificially consolidated sand models, representing one-quarter of a five-spot, have been developed and used to study factors affecting miscible displacement. Sweep efficiency at breakthrough, size of the mixing zone between two miscible liquids and per cent area contacted by drive after breakthrough were determined for the high mobility ratios encountered in actual reservoirs. Quantitative relationships between the degree of viscous fingering and mobility ratio were obtained by measuring the length of the fluid interface.

Recovery of Oil by Displacements with Water-Solvent Mixtures. R. J. Blackwell, W. M. Terry, J. R. Rayne, D. C. Lindley and J. R. Henderson. *J. Petrol. Tech. 12,* (Tech. Paper 8136) 272B (1960) Nov. (2 pp.)

Earlier investigators suggested that injection of a mixture of water and solvent could result in improved oil recoveries by taking advantage of the high displacement efficiencies characteristic of solvent floods and the high sweep efficiencies characteristic of water floods. The experimental investigation described was undertaken to develop a better understanding of the water-solvent process and to determine recovery efficiencies that might be expected for various reservoir situations. Laboratory models were used to investigate the effects of oil viscosity, gravity segregation, water-to-solvent injection ratio and permeability variations on oil recovery.

Well Practice

Foaming Agents Remove Water from Gas Wells. R. G. Schmidt. *Petrol. Eng. 32* (Drilling and Producing), B-51 (1960) Dec. (4 pp.)

Foaming agents mixed with alcohol and injected into water-logged gaswells by means of a simple surface hookup for both tubed and nontubed wells have successfully removed from one to five barrels of water daily from 12 problem wells in the Hougoton field (Kansas). Novel method has more than doubled producing rates on some of the problem wells slightly less than 3000 ft deep.

Hydraulic Units Save Workover Dollars. *Petrol. Eng. 32* (Drilling and Producing), B-29 (1960) Dec. (3 pp.)

"If transportation and rig-up costs were cut in half, we could show a decent payout on the workover of some of our hard-to-get-to wells." This statement by a South Louisiana operator points up one of the conditions that have led to the development of two new compact, all-hydraulic workover units now in the field. The new units are designed to reduce transportation and rig-up costs as well as to provide savings on workover jobs in wells with small tubing under pressure.

135 Cu Ft Gas Lifts 1 BBL Fluid at Delhi. L. F. Ellison. *Petrol. Eng. 32,* (Drilling and Producing) B-54 (1960) Nov. (8 pp.)

Unusually high lifting efficiencies have been achieved by a carefully engineered gas lift system in the Delhi field, Louisiana. Although the system was designed on the basis of about 167 CF of gas per bbl of fluid produced, production data indicate that on the average, one bbl of fluid is being lifted by only 135 CF of gas. And, although a high percentage of the produced fluid is water, the direct lifting costs average about a nickel per bbl of oil.

New Pipe Configuration Reduces Wall Sticking. F. K. Fox. *World Oil 151,* 83 (1960) Dec. (5 pp.)

Differential sticking is the unbalanced hydrostatic pressure which exists when there is a differential of unequalized hydraulic pressure across the pipe. This phenomena will result in an unbalanced pressure condition causing the pipe to be held against the wall of the borehole. Author presents informative discussion of wall sticking and describes how condition may be alleviated.

4. GAS CONDITIONING AND LPG RECOVERY

Dehydration

Prevention of Hydrate Formation in Refrigerated Overhead Condenser and Accumulator. F. E. Gilmore (assigned to Phillips Petroleum Co.) U.S. 2,956,411 (1960) Oct. 18.

In a de-ethanizing process for a feedstock containing moisture, hydrocarbons above ethane, and other hydrate-forming material, an improvement is claimed. This comprises cooling the overhead from the fractionating zone to condense part of the moisture, adding a desiccant solution such as lithium bromide or calcium chloride to uncondensed overhead and passing it to a refrigerated condenser. The cold condensate gives up water to the desiccant which is decanted, and the separated condensate is returned to the fractionator as reflux.

Process and Apparatus for Dehydrating Gas. S. C. Kennedy and R. S. Sheldon (assigned to Kahn and Co., Inc.) U.S. 2,955,673 (1960) Oct. 11.

Apparatus is claimed for producing dehydrated gas, particularly air. This comprises a compressor, a tower packed with desiccant, and a storage tank for dried gas. Flow control means provide for cyclically stopping the flow of compressed gas into the tower, and permitting reversed flow of dried gas from storage through the tower to flush out accumulated moisture. The flow reversal may be controlled by a pressure relay or internal timer.

Dust Removal

Electro Precipitators: Practical Design Aspects. J. E. Sayers. *J. Inst. Fuel 33,* 542 (1960) Nov. (11 pp.)

Paper considers the various design factors and operating conditions which have a major influence on the performance of an electro-precipitator installation. Emphasis is placed on the importance of the detailed design and layout of the discharge and collecting electrode systems and of the necessity for efficient cleaning of the electrodes and effective dust disposal arrangements. Reference is made to the effects of the electrical characteristics of the dust and the carrying gas, and to the desirability of pretreatment of the dusty gas to maintain controlled conditions of temperature and humidity in certain cases.

Residual Dust Profiles in Air Filtration. D. G. Stephan and G. W. Walsh. *Ind. Eng. Chem. 52,* 999 (1960) Dec. (4 pp.)

Regardless of the cleaning technique, no amount of cleaning ever removes all of the collected dust from a fabric filter medium; that which remains following the cleaning period is the "residual" cake. In bag-type air filters, significant differences in the residual cake are inherent over the surface of the filter. These differences are discussed and analyzed, and the reasons for varia-

tions in residual cake properties as well as practical implications to be gained from a knowledge of them are treated.

Hydrocarbon Recovery

Here's How Kerr-McGee Handles Offshore Condensate. W. B. Bleakley. *Oil Gas J. 58,* 157 (1960) Nov. 14 (3 pp.)

Offshore Louisiana is dotted not only with drilling platforms but with gas-handling facilities as well. One of the major contributors to this flurry of activity is Kerr-McGee Oil Industries, Inc., which is now operating three gas-condensate separation and dehydration plants offshore. Latest addition is the platform at Ship Shoal Block 28 field offshore Terrebonne Parish. Other central separation and delivery points are located at Breton Island, southwest of New Orleans, and at Main Pass gasfield, south of the Mississippi delta.

Lean Pipeline Gas Is Squeezed Dry . . . by Huge Extraction Plant. J. A. Sutherland, W. M. Hathaway and P. W. Eatman. *Oil Gas J. 58,* 64 (1960) Nov. 28 (3 pp.)

Plant described has capacity of 650 MMCF/day, recovers more than 90% of the propane in the inlet gas, generates its own power, and has complete fractionation facilities for handling 316,000 gallons of product per day. Total fuel consumption is less than 1% of the inlet-gas volume, and gas pressure loss through the plant is about 10 psi.

Hydrogen Sulfide Removal

Amine Units Sweeten Sour Gas in the Field. G. Ellis. *Petrol. Eng. 32* (Drilling and Producing), B-68 (1960) Dec. (4 pp.)

Operating problems are not as prevalent in the amine process of gas sweetening as in some other processes. Still problems do exist and some knowledge of them is important. Economy results from controlling corrosion by acid gases and degradation products, preventing solution losses from reaction with impurities, amine degradation, foaming and mechanical leaks.

The Derivatographic Investigation of Gas Purifying Materials. Part 1. M. Weltner. *Gas J. 304,* 273 (1960) Nov. 9 (4 pp.); **Part 2.** *Ibid,* 317 (1960) Nov. 16 (7 pp.)

Since the appropriate crystalline modifications have several forms, it is only natural that a study of the structure of gas purifying materials and the mechanisms of hydrogen sulfide removal should be a problem of great complexity. Derivatographic analysis, developed in Hungary, opens up new possibilities for study of the structure of these materials. Method makes it possible by a single, automatically recorded measuring process to obtain change in weight of the sample during heating. Its chief advantage is that it is possible to carry out a continuous measurement by instrument of the rate of loss of weight.

Double-Duty Process May Replace Claus. *Can. Chem. Processing 44,* 57 (1960) Nov. (2 pp.)

Haines process referred to in title utilizes the properties of the crystalline zeolite in two ways: first, as the adsorption medium; and second, as an effective catalyst for the Claus conversion of H_2S to elemental sulfur. Instead of regenerating the zeolite with air or nitrogen, the inventor proposes to use an air-SO_2 mixture. The SO_2 first displaces the adsorbed material as regeneration starts; then part of the H_2S burns, supplying heat for the endothermic reaction of H_2S and SO_2 to form steam and sulfur vapor (the Claus conversion). The sulfur vapor is later condensed, and one-third of it is burned to form the SO_2 needed. The temperature in the zeolite bed climbs to 600°F, at which point it is almost entirely stripped of its adsorbates.

Nitrogen Removal

Manipulation of Nitrogen-Contaminated Natural Gases. L. S. Twomey. U.S. 2,959,022 (1960) Nov. 8.

Process for manipulation of natural hydrocarbon gas contaminated with nitrogen is claimed. Method comprises first refrigeration and then fractionation, the latter employing a reflux liquid to separate the nitrogen vapor from the hydrocarbon-enriched liquid. A portion of the vapor is heat exchanged with a portion of compressed gas to produce a liquid refrigerant. This liquid refrigerant is heat exchanged with a second portion of compressed gas to produce a second liquid refrigerant having a lower boiling point than the first. The latter refrigerant is expansion-evaporated to produce at least a portion of the reflux liquid used in the fractionation.

5. NATURAL GAS TRANSMISSION

Engines

Jet Engines Starts Moving Gas. *Oil Gas J. 58,* 147 (1960) Nov. 21; **Aircraft Jet-Engine Thrust Harnessed for Natural Gas Compression.** *Gas 36,* 102 (1960) Dec. (2 pp.)

First jet aircraft engine to be adapted for natural gas transmission started operating in mid-November at the Clementsville, Ky., compressor station of Columbia Gulf Transmission Co. Event was a milestone in harnessing aircraft jet thrust for stationary power, and in introducing a new family of jet-powered gas turbines from 350 to 15,000 hp (see *Gas Abstracts 15,* 303).

LPG

LPG Linkup Lifts Ohio's Potential. *Chem. Week 87,* 21 (1960) Dec. 3 (2 pp.)

Petrochemical processing is now in the offing for Ohio's big chemical centers at Ashtabula and Painesville. Reason: new 96-mile pipeline joining "Little Big Inch" and Buckeye natural gas networks could bring C_3-C_5 liquids from Texas at low carrying costs.

Metering

Automatic Pressure Compensation. N. L. Hawes. *Instruments & Control Systems 33,* 1931 (1960) Nov. (5 pp.)

Smaller flowmeter can be used to measure large flows if the gas is measured at a higher pressure. This requires pressure correction (compensation) for reduction to standard conditions. Examples show the cost advantages of high-pressure measurement with automatic pressure compensation. Tests on flows of billions of SCF revealed that automatic compensation techniques were more accurate than manual techniques.

Pipeline Construction

Building the Big Mid-America Line. B. Quarles. *Pipeline News 32,* 40 (1960) Nov.

Mid-America Pipeline Company system is the first major pipeline constructed exclusively as a common-carrier LPG facility. The line originates at Hobbs, New Mexico, then branches near McPherson, Kansas. One leg of the system runs to Pine Bend, Minn., a few miles south of Minneapolis, and the other terminates at Janesville, Wisconsin, near Madison. Ultimate design capacity of the new system, when the line is fully powered with the maximum horsepower in pump stations, is 85,000 bbl/day. Initial throughput will be about 40,000 bbl/day after the short transition period when the line first goes on stream.

Submarine Pipeline Construction Methods. Part 1. J. G. Bomba. *Pipeline Eng. 32,* D-28 (1960) (5 pp.)

Six basic problems are present in considering any submarine pipeline installation: economics, hydrologic effects, meterologic effects, bottom conditions, marine traffic, and the properties of the pipeline itself. Experience of one construction company in developing methods and equipment to eliminate or minimize the effects of these problems on pipelines during and after installation is discussed by author.

Pipeline Operations

Computer Comes Up with Answer on Pipe Line Operations. D. W. Dreier and B. A. Sachs. *Pipe Line Ind. 13,* 62 (1960) Nov. (4 pp.)

Trans-Arabian Pipe Line Co. (Tapline) finds out in advance what will happen if its marine terminal is tied up by storms, if stations should fail, etc. Results thus far indicate that simulation model which enables them to do this realistically represents the actual system. The model is extremely sensitive (as is the real system) to: 1) number, size, pattern of ship arrivals; 2) distribution of turbine downtimes; and 3) frequency and duration of storms at Sidon.

Local Automation at Transwestern's Unattended Compressor Stations. R. W. Smith, Jr. and J. G. Vletas. *Pipe Line Ind. 13,* 51 (1960) Nov. (6 pp.)

From first to last, Transwestern Pipeline Co.'s compressor stations are designed for unattended, automatic operation. The stations are almost identical. Each one is powered by two 3500-hp LSV 16's driving RFB-24 centrifugal compressors through a gear speed increaser. This equipment is proving flexible, efficient and reliable. What's more, the engines are easy to start.

A Thin-Route, Beyond-the-Horizon VHF System Controls Middle East Stations. J. D. Hoffman. *Pipe Line Ind. 13,* 44 (1960) Nov. (7 pp.)

By applying a thin-route technique in an economical, integrated, small-scale very high frequency (VHF) system in the 156-174 mc band, Trans-Arabian Pipe Line Co. was able to achieve point-to-point multichannel voice, teletype and mobile communications between the main office in Beirut, Lebanon, and pumping stations and mobile units along the route of the line through Lebanon, Syria, Jordan and Saudi Arabia. In addition, the system is providing supervisory control for 5000 hp remotely-controlled pumping stations.

Transportation of Normally Gaseous Fluids in Pipe Line System. G. B. McConkey (assigned to Sun Oil Co.) U.S. 2,958,205 (1960) Nov. 1.

Method and means is claimed for transporting natural gas in a pipeline system by pumping at −205°F and 1100 psig to convert the gas to liquid. The liquid is kept cold by allowing vaporization when the liquid has travelled 65-95 per cent of the distance between pumping stations. Separated gas is reliquefied and reinjected at each station.

Variable-Diameter Pipe Line Scraper. A. M. Hill, P. A. Howard and J. A. Fugate (assigned to Service Pipe Line Co.) U.S. 2,958,884 (1960) Nov. 8.

Expansible scraper device for cleaning pipelines is claimed which comprises the smaller tubular carrying member with propelling cups at the front and wire brush scrapers at the rear. The improvement consists in the folding-tong mounting of the brushes, permitting radial movement to various diameters of pipe by means of a coil spring. The tongs swing outward on hinged brackets through slots staggered lengthwise in the carrier wall and spaced circumferentially around the carrier.

Telemetering

Instrumentation, Controls, and Automation. M. T. Nigh. **Part 2. Telemetering.** *Pipeline Eng. 32,* D-35 (1960) Oct. (3 pp.); **Part 3. Telemetering.** *Ibid.,* D-33 (1960) Dec. (3 pp.)

Topics of discussion include final delivery relay operation, control and supervisory indication, centralized monitor system, proposed control for starting unattended motor, time impulse analog telemetering and time impulse pattern.

Small Company Telemetering. C. E. Pigg. *Gas Age 126,* 21 (1960) Dec. (3 pp.)

Author presents case history of centralized control of pressure and meter loads in the Petersburg, Va., area. The advent of natural gas brought a phenomenal increase in customers and load to Petersburg and Hopewell Gas Co. which required a more systematic and automatic control of district pressures than previously. Telemetering is paying off for the company in manpower savings, peak shaving, better operation and better customer relations. Company believes while the investment in control equipment may have been excessive for a small enterprise, that the expenses involved are more

than compensated for because of the previously-mentioned advantages.

6. GAS AND LPG STORAGE

LPG

The Dealer's 3 R's of LP-Gas Cylinder Maintenance. Retesting, Repairing, Reconditioning. C. F. Brown. *LP-Gas 20*, 17 (1960) Dec. (5 pp.)

Author points out that safety and economy are important factors in the maintenance of cylinders for LPG distribution, and then goes on to show how dealers can comply fully with Interstate Commerce Commission Regulations and reduce costs at the same time.

Methane

Vessel for Storing Cold Liquids. C. D. Dosker. (assigned to Conch International Methane Ltd.) U.S. 2,954,892 (1960) Oct. 4.

Insulated storage vessel for low-temperature liquids is claimed. This comprises top and bottom rings of wood, with a number of bowed wooden ribs extending between, and spaced circumferentially around, the rings to form a supporting frame for insulating panels which form a complete enclosure. A thin sheet-metal lining (gas-tight) is fitted loosely within, designed to be held against the walls by the liquid when filled, and held, when empty, by the inner thin wooden spiders suspended from the top frame.

Methane Liquefaction

Cheaper Tanks for Liquefied Gases. *Petrol. Week 11*, 102 (1960) Nov. 11 (2 pp.)

The cost of building tanks to store or transport liquefied gases at temperatures down to around −320°F may be cut substantially as the result of tests showing that use of 9% nickel steel permits elimination of several costly fabrication steps. The alloy is suitable for making tanks to store or ship such gases as ethylene, which liquefies at −154.8°F, methane, which liquefies at −258.6°F; oxygen, −297.3°F; and nitrogen, −320.5°F.

Containers for Liquefied Gases. L. J. Clark and H. F. Goodman (assigned to North Thames Gas Board.) U.S. 2,959,318 (1960) Nov. 8.

Heat-insulating container for storing liquefied gas is claimed comprising multiple-wall construction. The wall comprises an inner shell of aluminum, an intermediate wall of thin corrugated sheets supported on vertical stanchions, and an outer wall of welded steel plates. Between the inner shell and intermediate sheets is a 2-in. air space. Between the outer wall and intermediate sheets is a 2-3-ft annular space filled with powdered Perlite insulation. These sheets are joined with flexible plastic sealant to permit contraction and expansion.

Process for the Liquefaction and Reliquefaction of Natural Gas. H. Knapp (assigned to Conch International Methane Ltd.) U.S. 2,959,020 (1960) Nov. 8.

Natural gas, vaporized from a previously liquid state, is reliquefied by the process claimed. The main stream of gas is compressed in several stages, with removal of compression heat by expanding with work a portion of the main stream and passing the latter cold expanded gas in heat exchange with the main stream. The last stage gas at 2000 psi and 100°F is also cooled by flashing of condensate.

Tank Cars

Innovations Galore on "World's Largest" Transports. *Butane-Propane News 22*, 50 (1960) Nov.

Mammoth truck transports, which operate out of Tuloma Gas Products Co.'s Salt Lake City terminal, are 60 ft long. Each carries 11,287 gallons of gas. Highway giants debuted only months after the Tulsa-based LPG supplier introduced its "world's largest tank car" as part of a continuing plan to increase the size and efficiency of its transportation facilities. The big V-12 engine is the first of its kind to be converted to LPG.

Underground Storage

Biggest LPG Cavern Finished. *Oil Gas J. 58*, 112 (1960) Nov. 14.

Sun Oil Co. formally completed the world's biggest mined LPG storage cavern in early November. With a capacity of 400,000 bbl, or 16,800,000 gallons of liquefied propane, it is the largest cavern ever hewn from a single shaft. The massive new cavern is the last of three carved from solid granite in Sun's Marcus Hook refinery.

Heat Transfer Characteristics of Porous Rocks. D. Kunii and J. M. Smith. *A.I.Ch.E. J. 6*, 71 (1960) Mar. (7 pp.) [From *Appl. Mech. Rev. 13*, 846 (1960) Nov.]

Equations are derived for predicting the effective thermal conductivity of beds of both consolidated and unconsolidated particles containing stagnant fluid. The effective thermal conductivity at these conditions is a function of the thermal conductivities of the solid and liquid phases, the void fraction, and if radiation is important, the emissivity, mean temperature and diameter of the solid particles. Comparison with the available experimental data indicates that the equations are satisfactory for fluids and solid particles of both high and low thermal conductivities. The equations also correctly predict the effect of void fraction and solid and fluid thermal conductivities on the heat transfer properties of sandstones and sintered metal systems.

J. A. Clark, USA

LPG Storage Caverns to Grow 24%. R. B. Bizal. *Oil Gas J. 58*, 85 (1960) Nov. 28 (6 pp.)

Seventh annual LPG storage capacity survey shows more than 20 new projects just completed, under way, or planned. These will boost U.S. capacity to more than 60,785,000 bbl. Expansion is in salt cavities as well as mined caverns. Survey lists capacities by states, companies, type of formation, and product. Canadian storage space is growing, too, and statistics for this country are included.

Underground Storage at McDonald Field. J. M. Kunz. *Gas 36*, 89 (1960) Dec. (12 pp.)

Comprehensive description of McDonald Island storage field, owned and operated by Pacific Gas & Electric Co. When fully developed this field, located about 50 miles east of San Francisco, will provide an in-and-out yearly storage of some 30 billion CF. Having an estimated original gas volume of 178 billion CF, it is probably the largest producing field to be converted to storage. Storage of gas in the summer will be at an average of 150 MMSCF/day and withdrawal in the winter at rates ranging from 150 to 400 MMSCF/day, depending on field pressure. Thirty-two wells and two compressor stations, with a total of 10,500 hp, are planned for the storage project. Total cost has been estimated at around $25 million including the purchase of storage rights and cushion gas.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Acetylene

Putting New Pressure on Acetylene. *Chem. Week 87*, 60 (1960) Dec. 3 (3 pp.)

Engineers are forging ahead with design work on this country's first plant to use the Montecatini acetylene process. The unit is scheduled to go onstream in '61 at Diamond Alkali's Deer Park, Tex., plant. In process, specific heat is retained by operating the burners under pressure. It was found that if about 2% steam is injected into the feed gas, the burner could be run at 60 psi, with no loss in cracking efficiency and with good flame stability. Pilot operations at this higher pressure also showed that 1) up to 20 million Btu of heat from condensing steam can be recovered for each ton of acetylene produced; 2) soot generated by the partial-oxidation flame is much more easily removed from product streams; 3) the burner capacity is increased roughly fivefold, so smaller or fewer burners can be used; 4) compressor costs are reduced; and 5) acetylene polymers, formed as byproducts during the cracking reaction, are easily removed.

Which Acetylene Feed Is Best? D. C. Lockwood. *Petrol. Refiner 39*, 223 (1960) Nov. (4 pp.)

Four factors should be considered when selecting the feedstock for acetylene manufacture. These are: 1) basic yield of acetylene from feed pyrolysis; 2) heat requirement as it affects yield or fuel costs; 3) oxygen requirement; and 4) volume of reaction effluent. The first two factors, when combined, do not significantly affect overall yield. But the last two factors both favor heavier feedstocks. Thus, the price of light feedstock must be lower to offset these last two factors.

Ammonia

Catalysts Used in the Manufacture of Ammonia. D. J. Borgars and G. W. Bridger. *Chem. & Ind.*, 1426 (1960) Nov. 19 (7 pp.)

Natural gas and refinery gases are the raw material for 40% of the world's production of ammonia. A large proportion of these hydrocarbon gases are first converted to raw synthesis gas by reforming them with steam to give a mixture of carbon monoxide and hydrogen which is mixed with nitrogen, purified, compressed and ultimately converted into ammonia. The various stages in the commercial production of ammonia from hydrocarbon gases as raw material are described.

Butadiene

The Production and Utilization of Butadiene. A. A. Appleton. *J. Inst. Petrol. 46*, 367 (1960) Nov. (7 pp.)

In discussing this subject it is very easy to forget a very important fact, that the massive scale of this operation is not yet 20 years old, and that the impetus for making butadiene such an important material industrially really came in the early part of World War II. The major processes which have been utilized in this connection have differed at various times to suit the particular circumstances. Processes mentioned include: aldol, dehydrochlorination of dichlorobutane, *cyclo*hexane pyrolysis, alcohol dehydration, butene dehydrogenation, butane dehydrogenation, and cracking.

Catalysts

Solid State Reaction Study of Hydrated and α-Aluminas with the Nitrates of Nickel and Cobalt. J. N. Pattison, W. M. Keely and H. W. Maynor. *J. Chem. and Eng. Data 5*, 433 (1960) Oct. (2 pp.)

Report is concerned with the compound transformations that occur when a hydrated alumina (5% β-alumina trihydrate and 50% α-alumina monohydrate) mixed separately with the nitrates of nickel and cobalt is calcined at various temperatures ranging from 260°-1200°C. A similar study was made substituting α-alumina for the hydrated alumina. Finally, the hydrated alumina was calcined independently and was compared with the alumina compounds observed in the calcined mixtures.

Coal Carbonization

Apparatus for Heating Agglutinating Coal. H. G. Tufty (assigned to Wood Associates, Inc.) U.S. 2,955,991 (1960) Oct. 11.

Apparatus is claimed for producing an agglomerated furnace charge of reducible ore and coal char. This comprises a retort chamber enclosing an endless refractory conveyor. The superheated ore and preheated coal (powdered) are introduced from a weighing feeder to form a mixture on the conveyor. The heat of the ore provides carbonizing heat for the surrounding coal (retained by an insulating jacket), which reaches a plastic state and agglomerates on the belt. The chunks from the head of the belt are crushed to size by rolls and the fines removed. The sealed housing permits recovery of tars and gases for use in heating the retort.

Process for Carbonizing Coal in a Laminar Gas Stream. J. J. S. Sebastian. U.S. 2,955,988 (1960) Oct. 11.

Process for carbonizing finely divided coal (20-mesh) is claimed in which the particles are entrained in a current of oxygen-free steam and recycle gas. The improvement includes the devolatilizing action of steam with the coal carried in laminar flow through a tubular carbonizing zone at 1500°F and 100 psig. The laminar flow suppresses the collision and agglomeration of char particles. After removal of char by cyclone, the tar is condensed and a methane-rich gas is recovered. Additional rich gas is made by reacting char with hydrogen in a second zone.

Coal Gasification

Automatic Control for Pulverized Coal Gasification. T. Taniyama, O. Saeki, Y. Karota and T. Usamoto (assigned to Sumitomo Chemical Co., Ltd.) U.S. 2,957,758 (1960) Oct. 25.

In a process for automatically controlling the gasification of pulverized coal, an improvement is claimed comprising a split control of the air and steam flow into the generator. Coal flow is set at a chosen rate, and 80-90% of stoichiometric required primary oxygen and steam are added by settings of valves operated by controllers from flow detectors. A thermocouple in the outlet gases controls the admission of the remaining 10-20% of the oxygen to maintain uniform high temperature, and the CO_2 recorder-controller adjusts the steam supply to hold a low CO_2 content.

Coke

Petroleum Coke in Illinois Coal Blends for Blast Furnace Coke. H. W. Jackman, R. L. Eissler and R. J. Helfinstine. (Div. of the Ill. State Geological Survey, Circu. 305), 1960, 10 pp.

Coke made in a pilot-oven from petroleum coke blended with Illinois coals tended to be somewhat larger and heavier than the coke made from Illinois and low-volatile Pocahontas coals. The best pilot-oven coke was produced from blends including 15-20 per cent petroleum coke. Tumbler tests indicated that fine pulverization of the petroleum coke before it was blended improved coke strength. Cokes of good quality also were produced when the low-volatile constituent was half petroleum coke and half medium-volatile coal. A minimum of coke breeze was obtained from such blends.

Cracking

Moving Bed Catalytic Cracking. Part 1. General Process Design Relationships. A. W. Hoge, R. E. Ashwill and E. A. White. *Petro/Chem Eng. 32,* C-44 (1960) Nov. (8 pp.)

In 1960 Houdriflow HB process, a further improved and simplified version of the Houdriflow process, was offered to industry. Process conditions are modified so that all cooling coils are eliminated from the kiln and a so-called "heat balanced" operation is attained. Units of this type have been designed in sizes ranging from 3000 to 75,000 bbl/stream day and the first commercial installation soon will be under construction.

What You Should Know About Catalytic Cracking. Part 1. Kinetics. J. F. Crocoll and R. D. Jaquay. *Petro/Chem Eng. 32,* C-24 (1960) Nov. (7 pp.)

Theoretical treatment of catalytic cracking reactions is difficult because of the tremendous complexity of oxygen. For any given reaction and state of catalyst deactivation, a rigorous kinetic treatment should consider the various individual steps in the cracking reactions involved. These would include mass transfer of reactants to the catalyst surface, diffusion into catalyst pores, chemisorption on active sites, surface reaction via a carbonium ion mechanism, desorption and diffusion of products and reactants from the catalyst pores, and mass transfer back into the vapor phase.

Ethylene

Economics of Ethylene Production from Light Naphtha. J. Chrones and J. L. James. *J. Inst. Petrol. 46,* 337 (1960) Nov. (11 pp.)

As a feedstock for ethylene production, light naphtha is currently favored because of its ready availability at low price, giving high ethylene yields in low-cost, well-proven plants. It is predicted that this favored position will continue, further enhanced by the expanding use of the byproducts as sources of other petrochemicals. Paper examines the economics of ethylene production from light naphtha with particular emphasis on conditions pertaining to the United Kingdom.

Here's How Gulf Makes Million Pounds of Ethylene Per Day . . . for Sale to Other Users. *Oil Gas J. 58,* 198 (1960) Nov. 21 (3 pp.)

Over 1 million pounds of ethylene per day is being produced at Gulf Oil Corp.'s Port Arthur, Tex., refinery. Coupled with the production facilities are a 147-mile pipeline distribution system, delivering ethylene to a number of industrial customers within a radius of roughly 75 miles, and extensive underground storage facilities for both feedstock components and ethylene. The C_3 and lighter gas produced in Gulf's refinery processes is relatively rich in hydrocarbons suitable for ethylene production. The major production steps are 1) pyrolysis, 2) quench, 3) compression, and 4) recovery and purification.

The Kinetics of the Oxidation of Ethylene by Nitrous Oxide. A. B. Trenwith. *J. Chem. Soc.,* 3722 (1960) Oct. (5 pp.)

Oxidation of ethylene by nitrous oxide has been investigated at temperature between 555° and 602° and at pressures from 20 to 100 mm. The reaction is homogenous and the principal products are nitrogen, carbon monoxide, methane, and ethane; small amounts of acetaldehyde, hydrogen and hydrocarbons of high molecular weight were also formed. The overall reaction is complex, consisting of both the oxidation of ethylene and its free-radical induced polymerization. In the initial step, acetaldehyde is formed; this is followed by the reaction of ethylene with free radicals derived from the decomposition of acetaldehyde.

Gasification

Equilibrium Chemical Composition and Thermodynamic Properties of Air-Carbon Mixtures at High Temperatures. H. Y. Wachman, M. J. Linevsky and R. F. Lyon. *J. Chem. and Eng. Data 5*, 456 (1960) Oct. (6 pp.)

In the calculations reported, the constituents of the mixtures are assumed to be N,O,A,C, N_2, O_2, C_2, NO, CO, CN, and C_3. Calculations have been made of the free energy, enthalpy, entropy, average molecular weights, and mole fractions for equilibrium mixtures containing 1-30% carbon by weight in the temperature range 4000°-10,000°K, and pressures in the range 0.1-100 atm. Only representative portions of the data are reported.

Gasification of Fuels and Decomposition of Gases. R. Rummel. U. S. 2,953,445 (1960) Sept. 20.

Process of producing gas by reactions of carbon in a molten slag bath is claimed. Powdered coke and oxygen, blown tangentially into the slag reactor, produce turbulence in the slag, which is high in calcium oxide. This oxide is reduced by carbon to form carbon monoxide and calcium carbide. The crude slag containing the carbide is withdrawn, crushed, and passed to a separate reaction zone to react with steam. Acetylene gas is recovered and the spent slag is returned to the slag bath.

Naphthalene

Coke Oven Gas Naphthalene Absorbing Final Cooler. E. V. Schulte and H. T. Stirling (assigned to Koppers Co., Inc.) U.S. 2,956,639 (1960) Oct. 18.

Final cooler apparatus is claimed for coke oven chemical recovery plants, in which the spent cooling water carrying naphthalene is contacted with tar in the collecting sump at the base of the scrubbing tower. The spent water from the sprays is funneled to the lowest level of the sump, where it must rise through a layer of solvent tar. This tar is recycled over a sloped baffle system, which provides a large tarry dissolving surface over which the rising water must flow. Separate decanting seals are provided for overflowing tar and water streams.

Nitrogen Oxides

Formation and Quenching of Nitric Oxide in a Continuous Flow Furnace. D. L. Mordell, A. L. Thompson and G. Yano. *Can. J. Chem. Eng. 38*, 206 (1960) Dec. (6 pp.)

Prepilot plant facility for the thermal fixation of atmospheric nitrogen has been successfully built and operated. Gas temperatures exceeding 3000°K have been reached but the quenching rates available to fix the nitric oxide were found to be inadequate for the gases at these high temperatures. However, yields of 3.7% nitric oxide by volume have been realized experimentally.

Olefins

Industrial Chemicals Based on Ethylene and Propylene. A. F. Millidge. *J. Inst. Petrol. 46*, 353 (1960) Nov. (14 pp.)

Paper surveys briefly the wide field of chemicals stemming industrially from ethylene and propylene. The utilization of ethylene for polymer production (particularly to polyethylene and polystyrene) is very large, and increasing rapidly. The production of polypropylene will soon be absorbing large amounts of propylene. A considerable proportion of the world production of ethylene is converted into ethylene oxide and its derivatives. Large quantities of ethylene and propylene are, however, transformed into chemicals others than those cited, and these form the subject of the article.

Propylene

A New Catalyst for Oxidation of Propylene with Air. J. F. Woodham and C. D. Holland. *Ind. Eng. Chem. 52*, 985 (1960) Dec. (4 pp.)

Most of the published information pertaining to the catalytic oxidation of propylene in the gas phase is in patent literature, and cuprous oxide supported on various carriers is the catalyst most often mentioned. Because of the need for more information pertaining to catalytic oxidation of propylene, the project reported was initiated. Fifteen catalysts, sufficiently homogeneous to justify their evaluation with qualitative or semi-quantitative determinations of their behavior in a flow-type reactor were prepared.

Reformed Gas

Production of Town Gas by Continuous Reforming of Commercial Butane. E. Halfyard. *Gas Times 94*, 25 (1960) Nov. (4 pp.)

Among the first of the communities in the United Kingdom to benefit from a gas supply was that in the Island of Guernsey, which now enjoys the distinction of being the first to be served by a Simon-Carves Otto catalytic reforming plant. This plant, described in the article, was officially opened in October.

Sampling

The Sample, the Procedure and the Laboratory. W. J. Youden. *Anal. Chem. 32*, 23A (1960) Dec. (11 pp.)

Statistical approaches to evaluation of analytical procedures are described in terms understood by the non-statistician. Such techniques help pinpoint sources of discrepancies in analytical results.

Tar

Research in the Coal Tar and Benzole Industries. D. McNeil and K. H. V. French. *Gas J. 304*, 259 (1960) Nov. 9 (7 pp.)

Research activities in the coal tar and benzole industries follow three lines: 1) investigations aimed at increasing knowledge of the chemical constitution and physical properties of crude benzole, crude tar and products derived from them; 2) investigations into the industries' current processes with the objective of improving the efficiency, reducing the cost and improving the quality of the products of these processes; and 3) investigation of novel techniques for extracting and refining established products.

Water

Engineers Get First Look at Hydrate Process. *Chem. and Eng. News 38*, 60 (1960) Dec. 12.

In the Koppers Process, propane combined with seawater to form salt-free hydrate crystals. The crystals are separated from the mother liquor, washed and decomposed to yield potable water. Because the crystals form above the freezing point of water, the method requires less energy input than either freezing or distillation. Energy requirement for the propane hydrate process is 28% lower than that needed for the freezing process, which uses butane as the refrigerant.

How to Select Demineralization Systems. N. H. Prater and D. W. Antonacci. *Petrol. Refiner 39*, 261 (1960) Nov. (6 pp.)

Article presents data which enable selection of basic resins and system types. Capital investment and operating costs for ion exchange water treatment systems can also be determined.

8. GAS DISTRIBUTION

Distribution Systems

Ductile Cast Iron Pipe in Chicago's Gas Distribution System. J. L. Adkins. *Gas 36*, 51 (1960) Dec. (3 pp.)

Peoples Gas Light & Coke Co. has installed over 100 miles of ductile cast iron pipe in the distribution system during the past five years. The installation of ductile is the same as with gray cast iron so that no change in installation crews or method were necessary. Damage due to shipping or rough handling has been practically nil. Inspections are made of ductile iron installations where it is necessary to uncover this pipe in order to make tapes or connections. No evidence of corrosion has been found on these inspections. Ductile pipe has been installed in all types of soils and installations encountered in the Chicago area, and there have been no failures in any of the ductile pipe.

How to Design Low Pressure Gas Systems by the "ED" Method. J. M. Cummings. *Am. Gas J. 187*, 21 (1960) Dec. (4 pp.)

Well-designed gas systems insure adequate quantities of gas will be transported from the source of supply to points of usage and that the pipe sizes chosen will not be either too small or too large. An undersized line will result in low pressure; an oversized line cannot be justified economically. Simplified step-by-step design method, based on the general gas flow formula, used equivalent pipe diameters for sizing pipe to fit gas flow requirements.

New Air-Powered Driving Head Helps Reduce Jacking Costs. F. H. Abrew. *Am. Gas J. 187*, 33 (1960) Dec. (2 pp.)

New tool for use during pipe jacking operations that puts air to work more efficiently has been designed by a member of the Long Island Lighting Co. (New York). Basically, the new jacking head consists of three blow pipes interconnected with piping in the form of an inverted "T." The entire assembly is then connected to a single air line by means of a coupling at the top of the jacking head.

Odorization

Rochester Gas Develops a Portable, Lightweight, Battery-Operated Odorometer. R. W. Gilkinson. *Gas 36*, 67 (1960) Dec. (3 pp.)

Gas under a few inches of water pressure is directed to a glass flow rater with glass or sapphire float, and finally through additional aluminum tubing to the stem of a glass sniffer tube. At this point it is mixed with dilution air from the blower. The blower directs this air-gas mixture up through the top opening of the sniffer tube where the odor level test is made. The tester sniffs the 100% air close to the opening in the sniffer tube. While still sniffing the pure air, the gas control valve is slowly opened until the first change from ambient is sensed. This is repeated once or twice. A reading is taken and from the calibration chart provided with each instrument, the per cent gas in air value is obtained which represents the "threshold" odor level.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

New Data Simplify Residential Cooling Load Calculation. *Air Conditioning, Heating and Ventilating 57*, 54 (1960) Dec. (3 pp.)

At present there are three industry methods for calculating the heat gain of a house for the design of a central cooling system—set forth by National Warm Air Heating and Air Conditioning Association (NWAHACA), Air-Conditioning and Refrigeration Institute (ARI), and Institute of Boiler and Radiator Manufacturers (I-B-R)—together with a selection of various company-propounded methods, all acceptable by the Federal Housing Administration (FHA). However, heat gain totals produced by each of these methods have had no agreement with one another. Accordingly, FHA asked NWAHACA to explore what could be accomplished to resolve the wide diversity in heat gain calculation methods. Special committee has developed a procedure which is now in the hands of all three trade associations for their consideration. Target date for publication by the three groups is early 1961.

Tests Prove Feasibility of Solar Air Conditioning. M. Eisenstadt, F. M. Flanigan and E. A. Farber. *Heating, Piping and Air Conditioning 32*, 120 (1960) Nov. (7 pp.)

Engineering features of an ammonia-water absorption refrigeration system utilizing hot water from a flat-plate solar absorber for regeneration are discussed as a means of comfort cooling with solar energy. The tem-

perature of the hot water used for regeneration varies from 140° to 180°F, a range readily obtained with present-day commercial flat-plate absorbers. An intermittent cycle was tested and the resultant performance data is reported here. The objectives of this study were: 1) to determine the effects of hot water temperature and ammonia concentration on system performance; 2) to evaluate the practicality of the system; and 3) to apply the results of an intermittent cycle to a continuous cycle. The data collected indicate that such a system is thermodynamically feasible.

Air Pollution

Air Pollution—A Special Report. *Power 104*, 67 (1960) Dec. (48 pp.)

To put the manifold aspects of the pollution situation into perspective, the report deals first with the great ocean of air in which man lives and works. Then it takes a wide-ranging look at the many ways that living and working produce pollutants. With the elements of the problem identified and their interplay explored, the report then presents constructive approaches to solutions for the community and for the individual plant.

Burns Fumes as Fuel; Slashes Gas, Air Needs. K. Robe and G. Clark. *Chem. Processing 23*, 80 (1960) Dec. (3 pp.)

Several years ago a gas-fired incinerator was installed to handle fumes from four small varnish-cooking kettles at one manufacturer's Los Angeles plant. Larger version was installed in the phthalic and bodying kettles. Fumes are collected from each of the two enclosed vessels and conducted through 6-in. pipes to a plant-made vertical water scrubber. Fumes leaving the water scrubber enter the combustion chamber and are burned with natural gas. Outside air supply is adjusted to minimum amount. Vapors almost sustain their own combustion.

The Efficiency of Fibrous Aerosol Filters: Deposition by Diffusion of Particles of Finite Diameter. R. E. Pasceri and S. K. Friedlander. *Can. J. Chem. Eng. 38*, 212 (1960) Dec. (2 pp.)

Brief review is given of the derivation of a semitheoretical experssion for the filtration efficiency of fibrous aerosol filters operated at low velocities. The correlation is compared with new data taken from the literature and is presented in a simplified form for design calculations. The existence of a minimum filtration efficiency is discussed and theory and data are compared.

National Goals in Air Pollution Research. Surgeon General's *Ad Hoc* Task Group. U.S. Dept. of Health, Education and Welfare Pub. Health Service Pub. No. 804. (U.S. Govt. Print. Off., Aug. 1960.)

Report is concerned with nationwide needs within the next decade for research on the growing problems of community air pollution. It outlines specifically the Task Group's conclusions as to: 1) the identification of national goals for air pollution research; 2) the costs of such research; and 3) the recommended allocations of financial responsibility among the Federal Government, states and local governments, and industry. In considering the total research effort needed, the Task Group identified ten principal goals for detailed consideration: 1) effects on man; 2) agricultural effects; 3) economic losses due to damage to materials, soiling and reduced visibility; 4) measurement and identification; 5) meteorology; 6) atmospheric reactions; 7) surveys and monitoring; 8) control; 9) information, education and training; and 10) administrative and legal aspects.

Appliances

Norms Criteria and Evaluation for Qualification of Apparatus for Domestic Utilization of Fuel Gas in Italy. A. Bohm and G. Rezzonico. *Rivista dei Combustibili 14*, 621 (1960) Sept. (15 pp. Italian text.)

Report calls for the establishment in Italy of a qualification criterion for domestic gas apparatus, and illustrates the work done by C.I.G. in this field, the criteria in establishing the testing rules, and the testing apparatus used to determine the aptitude and safety conditions of domestic gas apparatus.

Cookers

Burners Get Powered Air. *Appliance Manufacturer 8*, 83 (1960) Nov.

Gas drop-in surface cooking unit developed by Whirlpool Corp. has "powered air" for the burners. A blower supplies a controlled amount of secondary air to each burner. Advantages gained: even heat distribution, more exacting control of cooking temperatures and easier-to-clean unit. Because the air supply comes from within the burner itself, all burners are sealed within the burner pan.

Industrial Heating

Dehydrating of Compressors Is Important Step for Tecumseh. A. Q. Smith. *Ind. Gas 39*, 9 (1960) Nov. (2 pp.)

Most important dehydration process performed by major manufacturer of refrigeration and air-conditioning equipment is done on all compressors, and condenser and evaporatory components. It is in this area that natural gas enters into the operations. There are 31 dehydrating ovens, each with a capacity of 480 compressors. They are batch-type in operation but conveyorized for ease of handling units. They have direct gas-fired external air heaters. All the ovens are on automatic control with approved safety devices and burn approximately 600,000 Btu/hr in the low-temperature range with a plus or minus 5° tolerance. Only dry air which has been passed through sova bead dryers is used to dehydrate the products.

Gas—It's the Fuel for Industry in Basildon New Town. E. Ford. *Gas J. 304* (Gas in Ind. Sect.), 296 (1960) Nov. 2 (5 pp.)

One of the most interesting experiments in community living since the end of World War II has been the conception of the "new town." Though designed to accommodate overspill populations, they have, in fact, been carefully planned and built as self-contained entities in their own right, each with its own residential and in-

dustrial areas. Conceived and constructed as symbols of the new age in town planning, it is significant that the new towns have turned to gas as the most up-to-date form of fuel, both for domestic and industrial applications. This is certainly true of the newest of all new towns in Great Britain, Basildon (Essex), which was not only the last to be designated, but, when completed, will be the largest of them all.

How American Chain Converted from Producer Gas to Natural. E. G. Mills. *Ind. Gas 39,* (Amer.) 3 (1960) Nov. (5 pp.)

Story of American Chain and Cable Co.'s conversion from producer to natural gas. Applications for natural gas include galvanizing, hardening, annealing, normalizing, carburizing, carbonitriding, tempering, drying and cleaning.

There's Gas Behind that Aluminum. *Gas J. 304* (Gas in Ind. Sect.), 303 (1960) Nov. 2 (4 pp.)

Largest consumers of gas in Wales, Alcan Industries Ltd., formerly Northern Aluminium Co. Ltd., is expanding its production facilities in a four-year program which is expected to cost some £10,000,000. The intention is to increase output to meet the growing needs of established markets and also to provide the means of efficient production of commodities for which a demand has more recently emerged.

Pilot Lights

All About Pilot Burners. Part 1. J. Lee. *Gas Heat and Comfort Cooling 11,* 29 (1960) Nov. (4 pp.); **Part 2.** *Ibid.,* 34 (1960) Dec. (3 pp.)

Most vulnerable component of a gas heating system is its pilot light. Complete, basic description of types of pilots, and what makes them go—or fail to go, is presented. In second part, author discusses bimetal differential expansion, mercury vapor, hydraulic and thermocouple pilots, as well as trouble-shooting couples.

Refrigeration

Household Refrigerator. W. L. Morrison (assigned to the Union Stock Yard and Transit Co.) U.S. 2,959,025 (1960) Nov. 1.

Apparatus is claimed for household refrigeration by circulation of cold, moisture-laden air. An independent compressing and cooling system maintains the food chamber walls at a temperature above dew point of the air. The moist air is compressed, cooled and expanded (water removed only on cooling stage) and recirculated in the supersaturated state.

Physical Properties of Thermoelectric Cooling and Progress in the Development of Suitable Materials. E. Justi. *Kaltetechnik 12,* 126 (1960) May (11 pp. German text.) [From *Appl. Mech. Rev. 13,* 841 (1960) Nov.]

Fundamentals of thermoelectric cooling as well as advances in technology of the applied materials are discussed in a way understandable to refrigerating engineers who are not familiar with solid-state physics. Therefore, physical details and economical views are only briefly mentioned. Prospects of a further increase of the thermoelectric efficiency are discussed.

From author's summary

Space Heating

Hydronic Heating Design for Commercial and Industrial Buildings. R. H. Emeric. *Air Conditioning, Heating and Ventilating 57,* 67 (1960) Dec. (14 pp.)

To engineers active in hydronic heating, as well as to less experienced practitioners, the data on low-pressure hot water heating presented is of great importance. It is the author's intention to present design techniques that provide top performance from this type of heating in commercial and industrial work.

What Do We Know About Infrared Comfort Heating? R. L. Boyd. *Heating, Piping and Air Conditioning 32,* 133 (1960) Nov. (9 pp.)

Article presents a comprehensive review of what is known about infrared comfort heating by quartz lamps and tubes and metal sheathed heaters, and perhaps more importantly what is believed to be known; i.e., those circumstances of position, movement, dress, wind conditions, and others, which cannot be so accurately measured but which can seriously affect the adequate operation of an infrared installation. A method of determining "watts input density" based on the amount of radiation delivered to a surface is also suggested.

10. EQUIPMENT AND INSTRUMENTATION

Computers

Digital Computers and Regression Analyses in Evaluating Plant Operating Data. F. P. Fisher. *Ind. Eng. Chem. 52,* 981 (1960) Dec. (4 pp.)

Advent of digital computers has enabled the use of powerful techniques of regression and correlation analysis in the evaluation of plant operating data. Because of the wide range of error present in operating data, specific computing procedures are necessary to obtain results in a minimum of time. Simple linear correlations and an expanded binomial relation are valuable in selecting terms for the initial regression equation. The regression study should begin with a linear relationship, unless the form of the equation is known. Nonlinear terms then may be added until a significant equation is obtained.

Fluidization

A Study of Aggregative Fluidization. G. Davies and D. B. Robinson. *Can. J. Chem. Eng. 38,* 175 (1960) Dec. (9 pp.)

Effects of size distribution on the expansion of a gas-solid fluidized system have been studied by the fluidization of glass beads and char particles by air in a 2¼-in. diameter column. Log-probability distributions of 5, 10,

25 and 100-fold size variation, with an average size of 271 microns, were tested. The results show that compared with the effect of particle diameter, size distribution has little influence on the shape of the bed expansion curves. Various correlations, and in particular that suggested by Zenz for particulate fluidization, have been tested using the single size measurements. It is concluded that up to the present time, no really satisfactory correlation for aggregative fluidization has been proposed.

Heat Transfer

Thermal-Contact Resistance in Finned Tubing. K. A. Gardner and T. C. Carnavos. *J. Heat Transfer 82,* 279 (1960) Nov. (15 pp.)

Interference-fit finned tubes depend for their heat-transfer capability upon a contact pressure between fin and tube. The bond resistance under such conditions is relatively small compared to the other resistances in the heat-flow path. At elevated temperatures, however, differential thermal expansion between fins and tubes completely relaxes the contact pressure and introduces an additional gap resistance; this may become a significant part of the total resistance to heat transfer. A theoretical method for predicting the gap resistance is derived in terms of the fin and tube dimensions, their physical properties, the fluid temperatures and heat-transfer coefficients, and the initial contact pressure.

Instruments

Instrumentation of a Pilot Plant. S. Brodnicki. *Chem. and Process Eng. 41,* 492 (1960) Nov. (8 pp.)

Since the real product of a pilot plant is not what comes out at the end but the information collected from the various sections, instrumentation of such a plant poses many unique design problems. Article describes some problems associated with the instrumentation of a pilot plant for a pressurized slagging coal gasifier, involving a process for the conversion of low-grade coal into gas.

Metering

Low Initial Cost Favors Turbine Pipeline Meter. W. W. Holt, Jr. *Oil Gas J. 58,* 70 (1960) Nov. 28 (2 pp.)

Large capacity turbine-type meters have a distinct advantage in initial cost over the single positive displacement meter or a bank of small p.d. meters. And, while the installation costs of the turbine and single p.d. meters are about the same, those of the bank would be considerably higher. Turbine meter has high accuracy and repeatibility is excellent, author says.

Piping

Design of Steam Tracing Systems for Protection Against Freezing. W. S. Cotton. *Can. J. Chem. Eng. 38,* 214 (1960) Dec. (6 pp.)

Process or service pipelines containing materials which freeze readily must be protected during shutdown periods in cold weather. The desired temperature may be maintained in the pipe by installing a steam-heated tube under the pipe, and enclosing both the pipe and tracer tube with the insulation. A rational thermal design method has been developed which permits the estimation of the heating requirements. The method may also be applied to tracers containing other heating media.

Selecting Materials for Process Piping. C. K. Aldrich. *Chem. Eng. 67,* 183 (1960) Nov. 14 (40 pp.)

As chemical plants turn to more severe operating conditions to boost yields and throughputs, process piping takes on added importance. More resistant, more expensive materials must be used, but choosing the "best" materials calls for careful analysis of corrosion resistance, first and installation costs, and maintenance. Includes directory of manufacturers and inventory of literature.

Process Control

Closed-Loop Computer Control Is Used on an Ammonia Plant. H. C. Bozeman. *Oil Gas J. 58,* 148 (1960) Nov. 14 (6 pp.)

Subject material of this article has been abstracted earlier. (See *Gas Abstracts 16,* 263.)

Computer Controls Big Cat Cracker. *Oil Gas J. 58,* 73 (1960) Dec. 5.

A 40,000-bbl fluid cat cracker at Standard Oil Co. of California's El Segundo refinery in Los Angeles is being controlled by a giant IBM 7090 located in the company's headquarters 450 miles away in San Francisco. About 50 instrument readings from the cracker's control room are continuously recorded, and every 72 seconds they are converted into electronic signals and transmitted to San Francisco. Readings are received in San Francisco on punched cards. The cards are fed into the 7090, and in about 5 minutes they emerge as another set of cards with the most profitable plant-control settings. As the results come out of the 7090 they are automatically teletyped to El Segundo.

World's Biggest Crude Unit Nears Computer Control. G. L. Farrar. *Oil Gas J. 58,* 143 (1960) Nov. 14 (5 pp.)

Electronic computer is optimizing operations on the No. 12 pipe still at the Whiting, Ind., refinery of Standard Oil Co. (Ind.). The 140,000 bbl unit is on open loop control. The computer reads 196 instruments every 4 minutes, and every 20 minutes it types out orders that originate from 75,000 stored instructions. These orders guide operations so that the unit operates at peak efficiency.

Temperature Measurement

Concerning a Method for the Measurement of Very High Temperatures in Nearly Transparent Arc Columns. R. W. Larenz. [*Nat. Aero. Space Admin. Tech. Trans. F-54,* from *Zeit. Phys. 129,* 327 (1951) No. 3 (16 pp. German text); Dec. 1960, $0.50.]

Report presents a method of measuring the temperature

distribution across an arc column by use of a spectrograph. An equation is developed for the determination of the electronic temperature that corresponds to the point of maximum spectral line intensity across an arc column. A graphical solution is given which relates the various parameters such as statistical weights, excitation potential, pressure, etc., to spectral line intensity and temperature.

Miscellaneous Temperature-Measuring Methods. E. R. Kebbon. *Instruments & Control Systems 33,* 1921 (1960) Nov. (3 pp.)

Pyrometric cones, temperature-sensitive crayons, pellets and paint, and thermography each provide a unique approach to surface temperature measurement. A noise thermometer also is described.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

"Casing *Promotes* Corrosion at Crossings Instead of Providing Protection." R. J. Kuhn. *Oil Gas J. 58,* 103 (1960) Dec. 5 (3 pp.)

Casings appear to be an overhang from old days before cathodic protection and before much of the fine welding work so commonly in use today was developed. Perhaps casings may not be totally eliminated but, author says, it seems that a great many could be eliminated. Both parties involved at a crossing would benefit, he contends.

Coatings

Plasma Arc: Hot News in Coating. *Chem. Week 87,* 45 (1960) Nov. 26.

Currently, some 250 plasma jet-spray units capable of applying these coatings are in use in the United States, and manufacturers look for a doubling of this business soon. Plasma spray coating is a process in which extremely high-melting-point materials (metals, oxides, carbides, nitrides, etc.) are subjected to temperature to 30,000°F, melted and then propelled at high velocity (up to 34,000 ft/sec) to base materials such as graphite, brass, steel, and certain reinforced plastics. About thirty spraying materials are being marketed so far. Three U. S. companies now furnish units for plasma spraying.

Corrosion

An Aspect of the Corrosion of Mild Steel by Combustion Gases. T. K. Ross, A. J. Macnab and B. E. Leyland. *J. Inst. Fuel 33,* 540 (1960) Nov. (3 pp.)

Short-term corrosion of mild steel by sulfur dioxide in reducing atmospheres above dewpoint is examined. The different nature of the attack compared with that experienced in the presence of oxygen is shown. The quantitative effects of temperature and concentration are such that in both cases the scaling rate varies with the square root of the sulfur dioxide concentration. In mixtures of sulfur dioxide and nitrogen, scaling proceeds approximately as the third power of the temperature, but the presence of hydrogen increases this relationship to about the fifth power.

Now: Anodic Corrosion Control. C. E. Locke, M. Hutchison and N. L. Conger. *Chem. Eng. Progress 56,* 50 (1960) Nov. (6 pp.)

Until this year the search for means of controlling corrosion in the chemical process industry had led to six methods: 1) selection of more corrosion-resistant materials; 2) coatings; 3) inhibitors; 4) nonmetallics; 5) design; and 6) cathodic protection. Anodic protection can now supplement this list. It is similar to cathodic protection only in that both are electrochemical methods of combatting corrosion. Article describes the application of anodic protection to sulfuric acid corrosion.

Electrically Balanced Well Structures Can Relieve Production Problems. V. C. Crites and M. K. Fjeldsted. *Oil Gas J. 58,* 96 (1960) Dec. 5 (7 pp.)

One of the largest and most obvious production expenses is for repair of corrosion damage in oil wells. Another less apparent expense is production losses attributed to wells becoming obstructed. It is known that corrosion, scale and wax deposition are correlated and controllable. Test installations show that some degree of control can be achieved over corrosion and deposition by bringing the well structure to an approximate electrical balance. In several instances electrically balancing has resulted in greatly increased production. In one well production jumped from 14.75 to 168 bbl/day. Approach to problem presented is not another application of cathodic protection; it is just the opposite. Electrical balancing is accomplished with a counterelectromotive force which prevents current from entering the structure. This balancing brings the oil string to substantially a neutral potential with respect to the surrounding soil, and the flow of current throughout the structure is reduced to a minimum.

Inhibitors

Inhibitors of the Corrosion of Iron. I. Effect of the Cation. P. Beckmann and J. E. O. Mayne. *J. Appl. Chem. 10,* 417 (1960) Oct. (3 pp.)

Examination has been made of the inhibitive properties of the hydroxides of sodium, calcium, barium, zinc and lead and a range of salts of benzoic, cinnamic, α-naphthoic, acetic, butyric, and chloric acids. The lowest concentration at which corrosion was inhibited at *p*H 6.5-7.0 was for the chlorates, 50; hydroxides, benzoates and acetates, 10-20; cinnamates, α-naphthoates and butyrates 5-10. Inhibition was almost unaffected by the nature of the cation. At *p*H 4.5-4.9, the lead salts only were inhibitive. Consequently, the earlier conclusion regarding the efficiency of the lead salts of long chain fatty acids has been extended to a number of other compounds.

Inhibitors of the Corrosion of Iron. II. Efficiency of the Sodium, Calcium and Lead Salts of Long Chain Fatty Acids. J. E. O. Mayne and E. H. Ramshaw. *J. Appl. Chem. 10*, 719 (1960) Oct. (4 pp.)

Inhibitive properties of the sodium calcium and lead salts of caproic, oenanthic, caprylic, pelargonic, capric, suberic, azelaic and sebacic acids have been examined in the *p*H range 4.0-6.0 at concentrations 10^{-5} to 10^{-2}N. The inhibitive efficiency increased with the length of the carbon chain up to a maximum at 8-9 carbon atoms. For a given acid, the lead salt was more efficient than either the sodium or the calcium salt. The most inhibitive salts examined were lead suberate and azelate.

Piping

Characteristics, Testing and Some Design Considerations Applicable to Glass Reinforced Plastic Pipe. R. M. Levy. *Corrosion 16*, 33 (1960) Nov. (4 pp.)

Author discusses types of plastic pipe: thermoplastics and thermosets, their glass properties, tensile strength, elastic limits, thermal conductivity coefficient and specific gravity. The resins used also are described. Properties of glass reinforced plastic pipe covered include operating conditions, corrosion resistance, weight, flow characteristics, antifouling characteristics, heat transfer and pipe strength. Also described are the pulsating pressure, sustained pressure (stress-rupture) and other tests conducted to determine bond strength between plastic and glass in terms of pipe performance. Possible applications for the pipe are mentioned.

Tetrafluoroethylene-Lined Pipe Has Lower Installed Cost Than Other High Temperature Piping. T. R. Thierry. *Corrosion 16*, 9 (1960) Nov. (3 pp.)

Article discusses reduced installation costs of tetrafluoroethylene-lined steel piping in comparison with glass-lined pipe and alloy piping. Description of how TFE-lined pipe is made and recent case histories of installations are given.

Plastics

Applying Reinforced Plastics in Corrosive Environments of the Process Industry. F. W. Arndt. *Corrosion 16*, 14 (1960) Nov. (6 pp.)

Design considerations for applying reinforced plastic materials of construction to corrosive service in the process industries are reviewed from an overall standpoint. Considerations affecting the basic design, such as material selection and fabrication techniques, are related to mechanical or structural characteristics. Factors concerning the application, such as strength required for normal service, mechanical abuse, thermal conditions and chemical attack are discussed. Design must also include considerations for installation, anticipated service life and variations in values caused by random production influences. Each of these items are related to case histories, and examples for employing these values to conventional design techniques are presented.

12. ANALYTICAL METHODS AND TESTS

Chromatography

Gas Chromatography of High Boiling Compounds on Low Temperature Columns. C. Hishta, J. P. Messerly and R. F. Reschke. *Ana. Chem. 32*, 1730 (1960) Dec. (4 pp.)

Special modification of the column in gas chromatography allows the rapid elution of high boiling compounds at lower temperatures. The column provides chromatograms showing good resolution and short retention times at temperatures as much as 150°C below the boiling point of the sample.

Rapid Gas Chromatographic Method for Determination of Carbon and Hydrogen. A. M. Vogel and J. J. Quattrone, Jr. *Anal. Chem. 32*, 1754 (1960) Dec. (4 pp.)

Modified gas chromatographic procedure determines carbon and hydrogen contents of organic compounds without the necessity of isolating the products of combustion. Combustion is conducted in an oxygen atmosphere and the oxygen serves as the carrier gas. A single run is completed in 17 minutes.

Gas Analysis

The History of Gas Analysis in Mining. E. A. C. Chamberlain. *Chem. & Ind.*, 1370 (1960) Nov. 5 (5 pp.)

History of mining is overshadowed by disasters resulting from defective ventilation. First reference to noxious gases in coal mining in Great Britain is found in a letter written about 1550. By 1880, when coal mining had become a large industry, the dangers of explosion increased. Practically all the gases that occur underground had been isolated and their chemical properties determined before the middle of the nineteenth century, but it was not until the end of the century that the physiological properties of the gases were studied and that the full significance of the toxic gases, carbon monoxide, hydrogen sulfide and oxides of nitrogen began to be appreciated. Author discusses these.

Electron Microscopy

Full and Partial Particle Replication Technique for Electron Microscopy. F. Leonhard, C. F. Cook, Jr. and F. R. Anderson. *Rev. Sci. Instruments 31*, 1181 (1960) Nov. (4 pp.)

State of the art and the principal problems of particle replication techniques have been reviewed. The objective was to obtain the highest reliability as well as the maximum geometrical and contrast resolution for the replication technique. To this end, further improvements and complementary developments of the now-known techniques of particle replication were made.

Mass Spectrometry

Determination of Tetramethyllead and Tetraethyllead in Gasoline by Mass Spectrometry. H. E. Howard, W. C. Ferguson and L. R. Snyder. *Anal. Chem. 32*, 1814 (1960) Dec. (2 pp.)

Rapid analysis of gasoline for tetramethyl- and/or tetraethyllead is accomplished by a mass spectrometric procedure. The mass spectrum of the sample is compared with the mass spectrum of two synthetic blends of known concentrations of tetramethyl- and tetraethyllead.

High Temperature Mass Spectrometer Sample System. H. M. Shin, H. K. Hahm, S. I. Kwon, S. H. Jo and S. B. Hong. *Rev. Sci. Instruments 31,* 1200 (1960) Nov. (3 pp.)

Analytical mass spectrometer, originally designed by General Electric only for gaseous samples, has been modified so that the sample system can be converted for application to solid samples at elevated temperatures up to 1000°C. Conversion is accomplished by the complete replacement of the sample system by a magnetically-operated device and a cavity furnace, the heater of which is thermally attached to the furnace body and servo-controlled to keep to the predetermined temperature within a fraction of a degree. The furnace body is a silica tube, 5 mm i.d. Replacement of the sample can be done within 10 minutes without breaking the major vacuum. Advantages and disadvantages compared to the Knudsen cell are also discussed.

Use of a Conventional Mass Spectrometer as a Detector for Gas Chromatography. L. P. Lindeman and J. L. Annis. *Anal. Chem. 32,* 1742 (1960) Dec. (8 pp.)

Volatile organic mixtures are analyzed by a combination of mass spectrometry and gas chromatography. The procedure allows the simultaneous determination of several components in chromatographic peaks which contain more than one component. Relative concentrations of components are calculated from mass spectra data.

Moisture Determination

Comparison of the Accuracy of Humidity Measuring Instruments. F. M. Flanigan. *ASHRAE J. 2,* 56 (1960) Dec. (4 pp.)

Importance of humidity control to various processing industries, as well as to comfort air conditioning, has stimulated investigation of the relative accuracy of humidity measuring instruments. Tests conducted on instruments in common usage, as outlined in article, indicate that reliable readings of relative humidity are given by a sling psychrometer or an air-aspirated hygrometer with intermittent wet bulb wetting and a hygroscopic-coated sensing element. However, hair- and diaphragm-type instruments do not respond to sudden humidity changes; and the reservoir-fed bulb wick is not at all reliable in the findings of the author.

Organic Sulfur

Determination of Organically-Bound Sulfur City Gas and Similar Gases by a New Combustion Method. K. Gunther. *Brennstoff-Chemie 41,* 326 (1960) Nov. 23 (4 pp. German text.)

Rapid combustion method using a quartz burner is described, with absorption of combustion gases accomplished by scrubbing in a following bead-packed column with 3 per cent hydrogen peroxide. Slight suction at the outlet of the bead column is needed. For field tests, a sample is measured by a test gas meter, and for laboratory tests gas is taken from sample tubes of known volume. The peroxide solution is titrated by conductimetric titration.

Olefins

Spectrophotometric Methods for Olefins. Colorimetric Determination of Conjugated Diolefins. A. P. Altshuller and I. R. Cohen. *Anal. Chem. 32,* 1843 (1960) Dec. (6 pp.)

Convenient and sensitive colorimetric procedure is used to determine isoprene and similar diolefins. The conjugated diolefins are reacted with *p*-nitrobenzenediazonium fluoborate in a 2-methoxyethanolphosphoric acid solvent. The isoprene complex absorbs at 490 mμ, and the butadiene at 405 mμ. The method is applied to air mixtures and liquid hydrocarbon solutions.

Particle Size

Experimental Determination of Particle Sizes and a Graphical Representation of the Size Distribution According to Rosin, Rammler and Sperling. W. Fritz. *Chemiker Zeitung 83,* 819 (1959) 24 (6 pp.) [From *Appl. Mech. Rev. 13,* 856 (1960) Nov.]

Technical behavior of a multitude of particles is determined not only by its chemical constitution but also, to a great extent, by the grain-size distribution of its constituent particles. This is represented mostly by the summation curve of the sieving remainder, it plays an important part in engineering processes such as sieving, sifting, centrifuging, settling, flotation, etc., in the design calculation of filtering plants, and calculation of pressure loss of flow through porous goods. It influences the density and strength of properties of sintered metals, briquets, ceramics and concrete.

K. J. DeJuhasz, USA

Petroleum

Metal Content of Twenty-Four Petroleums. J. S. Ball, W. J. Wenger, H. J. Hyden, C. A. Horr and A. T. Myers. *J. Chem. and Eng. Data 5,* 553 (1960) Oct. (5 pp.)

Some 24 petroleums were collected and analyzed semiquantitatively for 27 elements and quantitatively for vanadium, nickel, copper, and uranium. In addition, they were analyzed by the routine Bureau of Mines crude oil analysis method. These petroleums can be associated geographically with the oilfield and geologically with the producing formation.

Tars

Analysis and Characterization of Coal Tars by Solvent Extraction and Chromatography. G. V. Blunt and M. Vahrman. *J. Inst. Fuel 33,* 522 (1960) Nov. (7 pp.)

Procedure for the quantitative analysis of low-temperature tars based on solvent extraction and chromatog-

raphy is described. Material boiling below 150°C must be distilled first. Using slight modifications the method has been extended to the analysis of high-temperature tars. The reproducibility of results is good, and upwards of 85% of a tar is accounted for by the normal method. The losses are mainly due to the precipitation of interfacial solids on extraction of phenols from solution.

13. BASIC SCIENCE

Adsorption

Graphitic Oxide and Water: Heats of Immersion and Heats of Adsorption. W. H. Slabaugh and C. V. Hatch. *J. Chem. and Eng. Data 5,* 453 (1960) Oct. (3 pp.)

Present article is a report on the adsorption of water vapor on graphite oxide surfaces and the heat liberated when graphitic oxide is immersed in water.

Butane

Thermal Conductivity of Butane at High Pressure: Correlation with Other Gases. F. R. Kramer and E. W. Comings. *J. Chem. and Eng. Data 5,* 462 (1960) Oct. (6 pp.)

Thermal conductivity cell, capable of measurements at higher temperatures and pressures, was developed. The thermal conductivity of butane was measured in the liquid and gas phases in the region of the critical point, and in the single phase region at pressures well above the critical. An improved generalized correlation is presented for complex gases.

Carbon Dioxide

Thermal Properties of Carbon Dioxide in the Critical Region. L. B. Koppel and J. M. Smith. *J. Chem. and Eng. Data 5,* 437 (1960) Oct. (4 pp.)

In the present investigation, a flow calorimeter was operated so as to obtain enthalpy versus temperature isobars. This was accomplished by measuring the flow rate, fluid temperatures in and out of the test section (calorimeter), and the electrical energy supplied. Since the velocities are small and the calorimeter is horizontal, this expression is $Q = \Delta H$.

Dielectric Constants

Dielectric Constants of Imperfect Gases. 1. Helium, Argon, Nitrogen and Methane. D. R. Johnston, G. J. Oudemans and R. H. Cole. *J. Chem. Phys. 33,* 1310 (1960) Nov. (8 pp.)

Measurements from 1 to 100 atm have been obtained at one or more temperatures between −30° and 70°C by a special transformer ratio arm bridge operating at 10 kc; derived values of the Clausius-Mossotti function are of sufficient precision (0.1%) to justify comparison with theoretical pair fluctuation, polarizability and multipole moment interaction effects at higher densities. Helium shows a decrease of 0.3% and argon an increase of 0.1% and C-M at 100 atm, while nitrogen and methane show somewhat larger positive effects, especially at lower temperatures.

Diffusion

Temperature Dependence of the Binary Diffusion Coefficient of Gases. D. S. Scott and K. E. Cox. *Can. J. Chem. Eng. 38,* 201 (1960) Dec. (5 pp.)

Variation with temperature of the binary gas diffusion coefficient for the gas pairs N_2-H_2 and NH_3-H_2 is reported for the temperature range of 0°-300°C. The data were obtained using a steady state flow method, and the apparatus and experimental conditions relative to this technique are discussed. Although this method does not give absolute values of the diffusion coefficient, it is relatively simple and accurate. The extent of agreement of the data with equations for the prediction of gas diffusion coefficients is shown. Better results are obtained when these equations are applied to nearly ideal systems, such as the N_2-H_2 pair, rather than to gases which have highly polar molecules such as NH_3.

Equation of State

The Equation of State for Air. A. A. Vasserman and Y. Z. Kazavchinsky. *Inzhenerno-Fizicheskii Zh. 3,* 81 (1960) Apr. (4 pp. Russian text.) [From *Appl. Mech. Rev. 13,* 841 (1960) Nov.]

An equation of state for air is obtained; this equation is applicable for a range of densities from zero to two critical values for a wide range of temperature changes. A comparison of calculation results with the majority of all existing experimental data of compressibility is given. The equation of state obtained reflects the existing reliable experimental PVT-data for air with high precision, and it can be used for calculation of calorific values.

From authors' summary

An Equation of State for Hydrogen Valid at High Pressures. V. Cariati and A. DiCio. *Revista dei Combustibili 14,* 647 (1960) Sept. (7 pp. Italian text.)

The Van der Waals, Beattie-Bridgeman and Paoluzi's equations for hydrogen gas are examined. While the first two equations are practically useless above 200-300 atm, the very simple Paoluzi equation, $p = RT/V-0.016$, gives in the wide range, 0°-300°C and 1-2000 atm, an average deviation which is less than 1%.

Second Virial Coefficients of Neon, Argon, Krypton and Xenon with a Graphitized Carbon Black. J. R. Sams, Jr., G. Constabaris and G. D. Halsey, Jr. *J. Phys. Chem. 64,* 1689 (1960) Nov. (8 pp.)

Precise measurements of the adsorption of neon, argon, krypton and xenon on the highly graphitized carbon black P33 at coverages of less than 10% are reported. These data have been analyzed in terms of a virial coefficients treatment to yield interaction energies and apparent areas. Several models for the interaction potential, have been investigated, but no definite choice of a model can be made on the basis of these data. Various theories for obtaining the area from the data are dis-

cussed and compared with the usual BET method for determining the area of the black. Values for the isosteric heats of adsorption at zero coverage are also discussed.

The Virial Coefficients of Helium from 20 to 300°K. D. White, T. Rubin, P. Camky and H. L. Johnston. *J. Phys. Chem. 64,* 1607 (1960) Nov. (6 pp.)

Compressibility of gaseous helium from the boiling point of liquid hydrogen to 300°K in the pressure range one to 33 atm has been determined. The 22 experimental *PV* isotherms are represented by an equation of state containing three virial coefficients. The second virial coefficients are compared with those calculated from various intermolecular potential functions for helium suggested in the literature. The agreement is fair.

Fluid Flow

Fundamental Aspects of Solids-Gas Flow. Part 5. The Effects of Fluid Turbulence on the Particle Drag Coefficient. L. B. Torobin and W. H. Gauvin. *Can. J. Chem. Eng. 38,* 189 (1960) Dec. (12 pp.)

Article presents an analysis of the experimental evidence currently available on the effects of the free-stream turbulence on particulate momentum transfer, obtained from both wind-tunnel tests with stationary bodies and from single-particle systems in which the solid is moving freely with the stream. Original experimental measurements recently obtained with a radio-tracer technique also are included. The drag coefficient appears to depend primarily on the magnitude of the relative turbulence intensity and on the particle Reynolds Number, while acceleration has negligible effects.

The Solution of the Equation of Magnetohydrodynamics Describing the One-Dimensional Axisymmetrical Motion of a Gas in a Gravitational Field. E. V. Riazanov. *Appl. Math. Mech. (Prikl. Mat. Mekh.) 23,* 260 (1959) 6 pp. [From *Appl. Mech. Rev. 13,* 848 (1960) Nov.]

This gas is assumed to be moving unsteadily in a direction perpendicular to the axis of symmetry and to be inviscid, to be electrically a perfect conductor, and to have a negligible thermal conductivity. The magnetic lines of force are helical. It is shown that an exact solution of the governing equations can be found in which the fluid velocity is proportional to distance from the axis. The properties of this solution are discussed in some detail and conditions found for stable equilibrium and for the complete dispersion of the gas.

K. Stewartson, England

Transformation of the System of Equations of the Hydrodynamic Approximation of a Plasma. V. S. Tkalich. *Izv. Akad. Nauk USSR, Otd. Tekh, Nauk, Ser. Mekh. i Mash.* 122 (1959) No. 5 (2 pp. Russian text.) [From *Appl. Mech. Rev. 13,* 848 (1960) Nov.]

System of equations comprising the hydrodynamic approximation for the motion of N kinds of ions in a plasma, which is assumed to be a uniformly charged, incompressible, ideal fluid, is transformed into a vector equation and then formally solved. No applications of the formal solution are made and the paper has no engineering significance.

L. C. Woods, England

A Variable Density Single-Fluid Model for Two-Phase Flow with Particular Reference to Steam-Water Flow. S. G. Bankoff. *J. Heat Transfer 82,* 265 (1960) Nov. (8 pp.)

Physical model has been proposed for the bubble flow regime of liquid-gas flow which is in good agreement with the important features of the process. Some interesting observations were noted: 1) the flow parameter assumes different forms for flow in circular pipes and for flow between two flat plates. The equivalent diameter concept has been justified experimentally for single-phase turbulent flows; 2) the wall has been assumed to be wetted by a liquid so that the void fraction at the wall itself is zero.

Heat Transfer

The Accuracy of Measurement of Heat Flows with Heat Flow Meters. M. A. Kaganov and Y. L. Rozenshtok. *Inzh.-Fiz. Zh. 3,* 138 (1960) Mar. (5 pp. Russian text.) [From *Appl. Mech. Rev. 13,* 846 (1960) Nov.]

Error in the measurement of heat flow with thermoelectric heat flow meters is analyzed. The error is caused by two factors: 1) substitution of the temperature gradient by ratio of the temperature overfall on the transducer plate to its thickness (unsteady-state conditions), and 2) distortion of the heat flow pattern when the heat conductivities of the undisturbed media and of the transducer plate are not equal (steady-state conditions).

From authors' summary

Application of Variational Methods to Radiation Heat-Transfer Calculations. E. M. Sparrow. *J. Heat Transfer 82,* 375 (1960) Nov. (6 pp.)

Variational method is presented for solving a class of integral equations which arise in radiation heat-transfer problems. First, to demonstrate the formulation of radiation problems in terms of integral equations, consideration is given to a system consisting of two nonblack, finite, parallel plates. After a general description of the variational method, its use is illustrated by application to the parallel-plate system. Comparisons are made which show very good agreement with exact solutions.

An Experimental Study of the Effects of Nonuniform Wall Temperature on Heat Transfer in Laminar and Turbulent Axisymmetric Flow Along a Cylinder. R. Eichhorn, E. R. G. Eckert and A. D. Anderson. *J. Heat Transfer 82,* 349 (1960) Nov. (11 pp.)

Local and total heat-transfer measurements were obtained with both laminar and turbulent flow for various unheated starting lengths followed by linearly increasing wall temperatures. For laminar flow, agreement with theory was obtained, this agreement being improved by the Seban and Bond cylindrical curvature correction. The turbulent-flow results indicated preference for the theory of Seban. Isothermal equations represent tur-

bulent heat transfer within approximately 20 per cent when the wall-temperature variations are not too abrupt.

Geometric Factors for Radiative Heat Transfer Through an Absorbing Medium in Cartesian Co-ordinates. A. K. Oppenheim and J. T. Bevans. *J. Heat Transfer 82,* 360 (1960) Nov. (9 pp.)

Heat flux conveyed by diffuse radiation from surface A_1 and A_2 through an absorbing medium is expressed by the relation Flux = radiosity x integrated function of radiated distance, area angle and adsorption. This four-dimensional integral is transformed into a sum of one-dimensional integrals for the cases of opposite-parallel and adjoining-perpendicular rectangles. The results are suitable for numerical integration with any total absorption law obtained from the actual distribution of monochromatic absorptivities over the whole spectrum.

Heat Transfer and Effectiveness for a Turbulent Boundary Layer with Tangential Fluid Injection. R. A. Seban. *J. Heat Transfer 82,* 303 (1960) Nov. (10 pp.)

Experimental results are presented for the effectiveness and for the heat-transfer coefficient for a film cooling system in which air was used both for the film and for the free-stream fluids. Correlations are realized for both the effectiveness and for the heat-transfer coefficient and, as in the past experience with such systems, separate specifications are needed for injection velocities greater and less than the free-stream velocity.

Heat Transfer to a Surface Reacting Fluid in Turbulent Flow. R. I. Rothenberg and J. M. Smith. *Can J. Chem. Eng. 38,* 184 (1960) Dec. (5 pp.)

Effect of chemical reaction on heat transfer has been studied for turbulent flow in tubes of a reacting gas. The analysis is carried out for a heterogeneous, catalytic reaction occurring at the wall surface. Equations are presented for predicting the increase in heat transfer coefficient due to reaction in terms of the rate of reaction, diffusion, and operating conditions. The equations are applied to the catalytic hydrogenation of ethylene. The results show that the total heat transfer coefficient can be at least tenfold larger than the coefficient for a nonreacting system at the same flow conditions. In general, the results of this study suggest that a wall-catalyzed reaction can be an effective means of increasing the heat transfer rate from gases in turbulent flow in tubes.

Mass and Heat Transfer in Flow of Gases Through Spherical Packings. J. DeAcetis and G. Thodos. *Ind. Eng. Chem. 52,* 1003 (1960) Dec. (4 pp.)

Contrary to usual assumptions, temperature of the packing surface is not the same as the wet-bulb temperature of the entering air, unless high air flow rates are used. Packed fixed beds and expanded fixed beds were used in this study. The expanded fixed beds were produced by randomly mixing the wet catalyst carriers with solid plastic spheres. Results obtained were similar for both types of packing.

A Note on the Relation of Biot's Method in Heat Conduction to a Least-Squares Procedure. S. J. Citron. *J. Aero/Space Sci. 27,* 317 (1960) Apr. (2 pp.) [From *Appl. Mech. Rev. 13,* 842 (1960) Nov.]

Author shows that a relation exists between Biot's variational method in heat conduction and the method of least squares. Author applies the method to study the temperature in the problem of the melting of a semi-infinite body under constant heat input. At the start of melting the temperature is known exactly and, therefore, a comparison between the exact solution and several approximations obtained by Biot's method can be made. A graph exhibits a remarkable divergence.

G. Sestini, Italy

Thermal Radiation from a Cylindrical Enclosure with Specified Wall Heat Flux. C. M. Usiskin and R. Siegel. *J. Heat Transfer 82,* 369 (1960) Nov. (5 pp.)

Thermal radiation is considered from the inside surface of a heated cylindrical enclosure. A specified heat input is imposed at the enclosure wall and the surface temperature distribution is determined. The analysis considers both black and diffuse gray-body radiation and obtains a simple relation between the two. The energy equation, which is a linear integral equation, is solved by three methods: 1) use of a separable kernel; 2) numerical integration; and 3) variational methods.

Transient Temperatures and Thermal Stresses in Hollow Cylinders Due to Heat Generation. J. E. Schmidt and G. Sonnemann. *J. Heat Transfer 82,* 273 (1960) Nov. (6 pp.)

General solution for the transient temperatures and thermal stress is obtained for a right circular cylinder with internal heat generation varying exponentially with the radius by use of Hankel transforms. Curves for the maximum thermal stresses are presented for diameter ratios up to 1.2 and for a variety of internal heat-generation rates for internal heat-generation transients with both cylinder walls maintained at zero reference temperature at all times.

Hydrocarbons

The Critical Temperatures of Forty Organic Compounds. D. Ambrose, J. D. Cox and R. Townsend. *Trans. Faraday Soc. 56,* 1452 (1960) Oct. (8 pp.)

Precise measurements have been made of the critical temperatures of pure specimens of 40 compounds drawn from the paraffin, olefine, cyclopentane, cyclohexane, benzene, pyridine and naphthalene series. The visual method of determining the critical point was employed and observed critical temperatures are believed accurate to within 0.1° in most instances. The results for compounds of the paraffin, olefine and benzene series have been combined with earlier measurements on other compounds of these series to yield correlating equations, which should prove useful for predicting the critical temperatures of compounds for which experimental data do not exist.

Volumes of Liquid Hydrocarbons at High Temperatures and Pressures. G. H. Alani and H. T. Kennedy.

J. Petrol. Tech. 12, (Tech. Paper 8135) 272A (1960) Nov. (2 pp.)

One of the major difficulties in predicting the performance of oil reservoirs from their early pressure history lies in the uncertainty of estimating the volume of the liquid hydrocarbons contained in them. As a first step in filling this need, an equation was developed to determine the molal liquid volume of pure hydrocarbons over a wide range of temperature and pressure. The second step consisted of adopting the equation to apply to mixtures, with he heave hydrocarbons expressed as C_{7+}.

Shock Waves

A Graphical Solution for Normal Shock Waves in Real Gases. C. E. Treanor. *J. Aero/Space Sci. 27,* 158 (1960) Feb. (3 pp.) [From *Appl. Mech. Rev. 13,* 830 (1960) Nov.]

Solution of the equations for conditions behind a normal shock in a real gas usually represents a tedious and time-consuming part of shock-tube research. Even for gases for which the thermodynamic properties have been calculated completely, the simultaneous solution of the Rankine-Hugoniot equations using graphs or tables of thermodynamic properties presents a formidable amount of numerical work. Author gives a very interesting rapid geographical method of obtaining such solutions. The accuracy is limited only by the accuracy of the graph available for the gas properties.

C. Franze, Germany

Thermal Conductivity

Measurement of the Coefficient of Thermal Conductivity of Liquids. L. P. Filippov and I. G. Pashenkova. *Inzh.-Fiz. Zh. 1,* 4 (1958) 81 pp., Russian text; *Ref. Zh. Mekh.* Rev. 6599 (1959) No. 6. [From *Appl. Mech. Rev. 13,* 841 (1960) Nov.]

Method and apparatus are described which make possible the measurement of the coefficient of thermal conductivity of liquids. The liquid under investigation is placed between two plane surfaces, the temperature of which changes with time in conformity with the linear principle. The coefficient of thermal conductivity is determined by measured values for the difference of temperature at two points in the liquid. Results are given for the measurement of the coefficient of thermal conductivity at 34°. The accuracy of the results is estimated at between 4 to 5%.

K. K. Vasilevskii

Courtesy Referativnyi Zhurnal, USSR

Thermodynamics

Applied Hydrocarbon Thermodynamics. Part 23. Evaluation of Vapor Fugacity and Activity Coefficients. W. C. Edmister. *Petrol. Refiner 39,* 233 (1960) Nov. (10 pp.)

There are two basic methods of evaluating the fugacity coefficients for the hypothetical vapor state: 1) extrapolating the vapor phase volumetric isotherms through the two-phase region and 2) extrapolating the vapor phase fugacity coefficient isotherms through the two-phase region. Extrapolating by equations of state might be considered partly volumetric and partly fugacity extrapolations.

Viscosity

Apparent Viscosity of Gas-Solid Fluidized Systems. F. F. Liu and C. Orr, Jr. *J. Chem. and Eng. Data 5,* 430 (1960) Oct. (3 pp.)

All beds exhibit rheological properties, and rheological behavior, moreover, is directly related to interparticle forces and interparticle friction, both of which are basic to a clarification of fluidization phenomena. In view of the unsatisfactory character of a paddle-type spindle, a new spindle was devised for use with a Model LVG Synchroletric viscometer. This spindle consisted essentially of two thin-walled brass cylinders located concentrically within one another and mounted axially to the viscometer through a small shaft.

Design and Operation of an Oscillating-Body Viscometer for Gases at High Pressures. J. Kestin and W. Leidenfrost. AFOSR TN 60-375 (Brown Univ., Div. Eng. TR 12) 79 pp., Mar. 1960. [From *Appl. Mech. Rev. 13,* 839 (1960) Nov.]

Report describes in detail the design and operating experience obtained with various types of oscillating-body viscometers of high precision. Satisfactory results could be obtained only with an oscillating system consisting of a flat circular disk oscillating between two flat plates a small distance apart. Oscillating systems involving a free disk or a free sphere suffer from instabilities and do not yield satisfactory reproducibility.

From authors' summary

Water

New Graph Relates Thermo-Physical Properties of Saturated Water, Steam. J. S. Hucks. *Heating, Piping and Air Conditioning 32,* 143 (1960) Nov. (2 pp.)

Data conveyed by the curves, relating to thermophysical properties of saturated water, have been assembled over a period of years during the course of work on heat transfer and fluid mechanics for nuclear reactor systems design. The curves relate various properties of saturated water to temperature in degrees Fahrenheit.

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The Institute of Gas Technology was founded in 1941 by members of the Manufactured and Natural Gas Industry to accomplish the following objectives:

1. *To train personnel for the Gas Industry.*
2. *To collect and disseminate scientific information of interest of the Gas Industry.*
3. *To prosecute basic and applied research for the Gas Industry.*
4. *To stimulate and correlate research within the Gas Industry.*

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